

SMALL-POX AND VACCINATION

IN

EUROPE

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A CONCISE HISTORY
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IN EUROPE.



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SMALL-POX AND VACCINATION
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BY
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PREFACE.

‘IS VACCINATION A PREVENTIVE OF SMALL-POX? To this question there is, there can be, no answer except such as is couched in the language of figures.’ Dr. W. A. Guy, F.R.S.S.

The object of this work is to supply in a handy form the chief official statistics, and some others relating to vaccination. A short historical account is also given of small-pox, of inoculation, of the introduction of vaccination—the greatest sanitary fact which the world has ever known—and of its progress during a hundred years in various European Countries.

I will here mention the Kőrösi method. Herr Kőrösi, director of the Budapest Statistical Bureau, procured from medical men exact information as to the vaccination condition of 14,678 persons who died from various causes, including small-pox, in some Hungarian Hospitals in 1886. It was found that the unvaccinated constituted 14 per cent. of those who died from ‘other diseases’ than small-pox. If vaccination has no influence on small-pox, then the unvaccinated should have formed also about 14 per cent. of those who died from small-pox. They actually formed 81 per cent. (‘*Kritik der Vaccinations—Statistik*,’ Berlin 2nd edition, 1889, and ‘*Trans. Internat. Med. Congress*,’ Washington, U.S., 1887, which also contains Kőrösi’s proof of the falsification of the Austrian railway returns).

The English nation is behind the times in the use of

vaccination. Whatever legislation is enacted as to vaccination in infancy, similar legislation must be enacted for school children. Italy, Hungary, Roumania, and Japan, besides Germany, have made revaccination obligatory at school-age.

Since vaccination is a national necessity, its administration should be entrusted to a central authority; and taken at once out of the hands of local Boards of Guardians—elected for the relief of the poor, which relief has nothing to do with vaccination—and blown about by every local wind of doctrine.

The vaccination of a single individual of a community increases the protection of all those already vaccinated in that community, hence, it is the right of the community to insist on the well-vaccinated condition of each individual, and this means revaccination.

The simple measure of universal revaccination in school-age would prevent epidemic outbreaks altogether. This is certain, and not mere theory; because another country has made the experiment for us, a quarter of a century ago, with the result that that country (Germany) is never troubled with epidemics; there are only a few isolated cases each year.

To go on with our present system of severe local epidemic outbreaks every few years, with enormous expense in isolating patients, to say nothing of the numerous deaths, and the breaking up of homes, is absurd, because unnecessary.

CONTENTS.

CHAPTER I.

EARLY NOTICES OF SMALL-POX	PAGE I
--------------------------------------	-----------

CHAPTER II.

SMALL-POX IN THE EIGHTEENTH CENTURY.	II
TABLES: Geneva—Copenhagen—Sweden—London (1629-1800)—Glasgow—Berlin—Boston—Liverpool—Leipsig.	

CHAPTER III.

INOCULATION OF SMALL-POX	24
Lady M. Wortley Montague's letter—Haygarth's scheme— Second attacks.	

CHAPTER IV.

THE INTRODUCTION OF VACCINATION	33
Edward Jenner—Pearson—Woodville's 'General Eruption' —Rapid spread of Vaccination abroad.	

CHAPTER V.

EARLY RESULTS OF VACCINATION	45
TABLES: Sweden—London—Glasgow—Stuttgart—Berlin —Copenhagen.	

CHAPTER VI.

SMALL-POX IN THE VACCINATED. REVACCINATION ERA BEGINS	51
TABLES: Sweden—Prussian Army.	

CHAPTER VII.

	PAGE
1.—EARLY THEORIES RESPECTING SMALL-POX IN THE VACCINATED.	
2.—TRANSFERENCE OF SMALL-POX TO COW.	
3.—NATURE OF COW-POX.	
4.—HORSE-POX	61

CHAPTER VIII.

THE MIDDLE THIRD OF THE LAST CENTURY	72
TABLES: Sweden—England (1838-1900)—London—Countries compared. The law as to vaccination in Prussia previous to 1874.	

CHAPTER IX.

THE GREAT EPIDEMIC, 1870-5: LESSONS TAUGHT BY IT	80
I. Countries compared—II. Age-classes—III. Once-vaccinated Bavaria—IV. The German Army—Results of German Vaccination Law of 1874—Table. All school children revaccinated in the twelfth year of age in Germany—German Vaccination Commission, 1884.	

CHAPTER X.

SMALL-POX AND VACCINATION IN RECENT YEARS	93
Direct and indirect evidence. Examples. Statistical direct evidence—Chemnitz—Bavaria—Leipsig—Sheffield. Six recent epidemics in England—Armies compared—Special classes.	

CHAPTER XI.

THE ROYAL COMMISSION AND THE GREAT SUR- RENDER	114
Special points in Final Report—Fatality of Vaccinated and Unvaccinated, especially in childhood—Warrington (Table)—Invaded Houses—Sanitary Improvements—Registrar-General's Table—Chief Conclusions of Royal Commission—The Duty of Parliament.	



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CHAPTER I.

EARLY NOTICES OF SMALL-POX.

It is still a matter of dispute whether any one of the various pests described by ancient Greek and Latin writers was small-pox.

Sixth Century.

The word 'variola' is first met with in a writing by Bishop Marius of Lausanne—A. 570... '*et variola Italianam Galliamque afflixit*;' but Sigbert of Gemblours mentions 'malae valetudines cum vesicis' (bad indispositions, with vesicular eruptions), as occurring in 541. To cite Bishop Marius again:—A. 571, '*Hoc anno infanda infirmitas atque glandula, cujus nomen est pustula, in suprascriptis regionibus innumerabilem populum devastavit.*' Other authors write grandula for glandula, and Wernher considers small-pox to be meant by the term.

Bishop Gregory of Tours doubtless described small-pox when he wrote of the 'Lues cum vesicis' (epidemic with vesicular eruption) in 582, for it began with sickness, fever and back pains (*renumque nimius dolor*), then the fever abated with the copious eruption of hard white vesicles, which were very painful and were called 'coralis' (*rusticiores vero 'Coralis' hoc pusculas nominabant*), which became pustules, and bad cases were fatal (amongst the young especially) on the 12th to 14th day.

Seventh Century.

Irish MSS. contain notices of 'Bolgach' in the years 675, 679, 680, (also 778). The word 'Bolgach' means small-pox (Bryan's 'Irish Dictionary'). 'Galar-breac' is a later term.

A lost work by Aaron, a physician of Alexandria in the 7th century, is referred to by Rhazes who cites a long passage—'According to Aaron the pocks are more favourable if they are white and red, bad pocks are green and black, and later on saffron; if the pocks (*djedri*) and measles (*hasbah*) distinctly appear, and the fever abates, it is a good sign....'

Ninth Century.

Isaacus Judaeus. The first clear description of small-pox by a physician, which has come down to us, is by Isaac the Jew, who lived in the 9th century. A MS. Latin translation of his work is in the Mainz Town Library—*Isaaci Israeliti . . . opera omnia*. Latin, reduct. Andr(eas) Turrin(us). Piscien. Lugd. (1516), in the

Collectio Veneta de febribus, Venet., 1594. Isaac's theory was—in order to account for the fact that small-pox attacked every one—that it was a natural fermentation of the blood in children, to get rid of a certain crudity or impurity acquired during intra-uterine existence.

Tenth Century.

Rhazes (Abú Bekr.....Ar-Razi), called the 'Arabian Galen,' born about 850, really belongs to the tenth century by his writings, and wrote copiously. He rejected the theory of Isaac, as regards the cause of the fermentation of the blood, and said it was a process natural to children because the blood in them is *like new wine* and must ferment. This is the celebrated 'theory of the Arabians.' His work 'De Variolis et Morbillis' (Latin Trans.) has the following title to the first chapter: 'Quare fiat, ut has non effugiat, nisi unus et alter ex hominibus.' (How it happens that no one escapes them [the small-pox], except one here and there) we gather from Rhazes that *small-pox was a children's disease, attacked almost every one, and second attacks were rare*, and due to incompleteness of the fermentation. Rhazes informs his readers that Galen knew small-pox, and that if any one doubts this, he has not read Galen. But his citations are not convincing on this point.

Avicenna (Ibn Sina) 980-1037, author of the 'Canon Medicinæ,' *sharply distinguished small-pox from measles*. He recognized the possibility of second attacks, like Rhazes, and, also followed him in opening the ripe vesicles on the seventh day, with a gold needle. Avenzoar (11th or 12th century, in Spain) went back

to Isaac's theory. Averroes, who came later, must also be named.

A Harleian MS. in the British Museum, end of 10th century, has an exorcism and prayer in Latin and A.S.'peto Angelorum milia me salvent.....*et de potestate variolæ,*' and the Saxon prayer runs thus...'*geskyldath me vid de lathan Poccas*' (shield me against the hideous pocks).

A Cottonian MS. of the 11th century has the words '*minutam variolam,*' referring to amulets bearing the name of St. Nicaise (d. 430, Bishop of Rheims).....*Sanctus Nicasius habuit minutam variolam.*

Ekkehard (Eccardus) relates that in the 10th century, the Abbot Notker of St. Gall treated Bishop Caminaldus for small-pox so promptly that no marks were left,—'*pustulasque tandem eruptas ita in brevi sanaverat ut nec saltem de una fuit signabilis.*' Ekkehard (quoted by Moore) uses the words '*variolarum morbum.*' Bald, a Saxon physician in England in the 10th century, recommended the opening of the pocks, like Rhazes: 'If they break one must delve away each of them with a thorn.' (See '*Leechdoms, Wort-cunning and Starcraft,*' Rev. O. Cockayne, 1865).

Thus small-pox existed from remote times not only in the East and Africa, but in Ireland, England, France, Switzerland, and Spain; and no doubt all over Europe. That the pitted face left so often by the disease was familiar is evident from Agnellus of the 10th century (Du Fresne's Dictionary), who describes a certain person as '*variolosus in facie,*'—variolous in aspect.

Eleventh to Fifteenth Century.

A list of sixteen early European physicians who wrote on small-pox during the 11th to 16th century, has been given by Gruner ('De variolis et morbillis fragmenta medicorum Arabistarum,' Jena, 1790). Gruner calls them all 'Arabists,' and certainly European medicine was Arabian medicine for several hundred years; but the shackles fell off at last when a few efforts at independence were made. We may mention Constantius Africanus, who taught at Salerno (the first European school of medicine); Matthæus Sylvaticus of Milan, the learned botanist; Gordonius of Montpellier, author of a compendium called 'Lilium medicinæ'; and Valescus of Taranta, who also settled in Montpellier and wrote the 'Philonium' embracing the healing art *in toto*. England boasts Gilbert Anglicus and Johannes de Gaddesden.

The Danish authorities report severe epidemics in Iceland, viz., in 1257, 1291. (Simon's 'Papers,' Append. 1st Rep. Roy. Comm.).

John of Gaddesden, an English physician of celebrity, author of the 'Rosa Anglica,' was such 'an Arabian' that he hung the patients' beds with red, and gave red coloured drinks, to promote diaphoresis, and acquired renown. The disease was also known to be **contagious** in England, for in a Chronicle in the British Museum which comes down to the year 1419, we read—'1366—Also that time fell a sekness that men call "ye pokkes," slogh both men and women *thorogh thev Enfecetyne*.'

Irish MS. mention 'Galar-breac' as epidemic in 1327,

and in 1368, near the time of the date mentioned in the 'English Chronicle.' 'Galar-breac' still means 'small-pox' in County Mayo.

Gilbert Anglicus, temp. Edward I, also treated small-pox, before John de Gaddesden.

The end of this century saw the spread of syphilis over many parts of Europe ('the French disease,' brought back from the siege of Naples by the French Army of Charles VIII.). It was then more acute than at present, and the secondary eruption received the name of pocks, hence variola came to be called 'the small pocks,' and it is so termed in Holinshed's 'Chronicle' written in the 16th Century.

The Irish, to indicate the new disease, added a word to 'bolgach,' making it either 'bolgach-francach,' or 'Gall-bolgach.'

The French called it the Neapolitan disease.

Thus the word variola at first meant 'small-pox.' In support of this we find that R. Cotgrave's Dictionary (1611) has—'vérole, the small pocks' to which he adds—'la grosse vérole, the Neapolitan disease' and asserts that the Spaniards brought the latter from the West Indies and 'bestowed it upon the French, their enemies, at the siege of Naples.' This is now an exploded theory.

Sixteenth Century.

Massa, (1513) writing from the West Indies, observes that syphilis was then as prevalent there, as 'small-pox in Europe.' This shows that small-pox was then very prevalent in Europe.

In 1520, small-pox was imported into Mexico, and

soon, according to Toribio, caused about 3,500,000 deaths (Simon's 'Papers'). In some places there was nobody left to bury the dead. Whole tribes of Red Indians were extirpated, *e.g.*, 100,000 in Quito (De la Condamine).

Mercurialis (b. 1530) says, 'almost every person must have-it once,' *i.e.*, small-pox.

Vidus Viduus, in 1550, asserts that small-pox attacks all persons in the course of their lives.

The terms 'small pokkes' and 'meezils' are first met with in a letter, July 14, 1518, in which Wolsey is informed that King Henry VIII. is leaving Wallingford on account of the prevalence there of these diseases and of 'the great sycknesse' (plague).

Bullein's 'Sickness and Health,' 1562, mentions a 'medicen' for the small-pox, also a lotion 'to anoint the faces of children that have the small pockes, when the said pockes be ripe, to keep them from pittes, or erres.' Here children are expressly mentioned.

Phaer's 'Book of Children' informs us that the symptoms of small-pox are so plain as to need no further mention.

Elyot (Castel of Health) and Kelwaye (1593) write similarly.

We have seen that the earlier physicians followed the Arabians, but a new spirit came into medicine about this time. Fracastor of Verona (d. 1553) calls variola a contagious disease, but otherwise followed the Arabian physicians.

Fernel (d. 1558) the physician of Henry II. of France, struck out a new line, and founded the miasmatic theory, for he ascribes all pests to corruption of the air by decomposing substances.

Foreest (d. 1577; Netherlands) favours the same theory, and mentions an epidemic of small-pox and measles together in Alkmar in 1551, when hardly a child escaped infection, and in Delft, 1562-3. Ambroise Paré, also Sennert, describe small-pox.

The old English Chronicle, already mentioned, speaks of the 'enfectyne of variola.'

We shall now meet with several authors who speak of small-pox as contagious. Donatus does so, referring to an epidemic in Mantua, 1567.

Willis in England (b. 1622)... "contagio hunc morbum ...serpere" (...that this disease creeps on by contagion... is shown by daily experience.....).

Riverius (b. 1589)..... 'a malignant character being communicated by contagion' (per contagium).

Seventeenth Century.

Sydenham (England 1624-1689) reformed the whole treatment of fever by substituting the cooling treatment, instead of the sweating treatment. He insisted on open windows, and in fact, broke away from tradition altogether. The cause of small-pox he found in 'the epidemic constitution of the atmosphere' due to unknown natural laws. Here he was wrong in not recognizing the contagiousity of variola. Small-pox was to Sydenham a specific inflammation of the blood, with two stages, a *stadium separationis* in which the inflamed particles are matured by nature in the blood, and a *stadium expulsionis*, in which they are deposited at the surface of the body as small abscesses and thus got rid of. He distinguished carefully measles from small-pox.

Sydenham is the English Hippocrates; the saving of life which his treatment effected is incalculable.

Von Helmont (Belgium, 1578-1644) asserted that the disease was contagious and that it was followed by an increased resisting power of the tissues—after their combat with the disease—against a second infection. His theory is thus one of ‘active immunity’ and in this he anticipated modern research.

Father Kircher of Rome (1601-1680) used his rough microscope to examine the contents of the pustules in small-pox. He was the first to believe in a *contagium animatum*—a living contagious element.

Salmasius in ‘De Annis Climacteribus’ (1648) writes, ‘.....variolas quas ad distinctionem parvarum, magnas indigitamus’—the poeks which we call the great, to distinguish them from the small-pox. This shows that the term ‘variola’ at first always meant the small-pox.

Boerhaave (1668-1738) took a median position between the adherents of the cooling treatment and the old school. He said that small-pox was contagious.

To show the prevalence of small-pox, it may be mentioned that Lord Dorchester in 1628, calls it ‘the popular disease.’

We now approach the era of statistics, but official statistics, with few exceptions, are a product of the 19th century.

For London, the registers of the parish church burials, with the causes of death in certain cases are given from the year 1629 onwards, they refer to London within the ‘Bills of Mortality,’ not to Suburban London. The Church Registrars of Geneva begin with the year 1580. Various other towns had similar registers, *e.g.*, Berlin, Württemberg, Kilmarnock.

Small-pox did not spare the palace and the throne; for the following died of it:—William II. of Orange, the Emperor Joseph I. of Germany (ætat 33), Louis XV. of France, two children of Charles I. of England, a son of James II. of England, also his daughter Queen Mary, and her uncle the Duke of Gloucester, the son of Louis XIV. (the Dauphin), Louis Duke of Burgundy, the Dauphiness his wife and their son the Duc de Bretagne, Peter II. Emperor of Russia, Henry Prince of Prussia, the last Elector of Bavaria, two German Empresses, six Austrian Archdukes and Archduchesses, an Elector of Saxony, and the Queen of Sweden (1741).

Further, the following were severely attacked:—Queen Anne of England, Peter III. of Russia, Louis XIV. of France, William of Orange (afterwards William III.), and especially Queen Maria Theresa of Austria.

Ben Jonson (d. 1637) wrote an epigram on small-pox.

‘ Envious and foul disease, could there not be
One beauty in an age, and free from thee? ’

Two more quotations may appropriately close this chapter. George Bell of Edinburgh in the beginning of the last century used these words: ‘The small-pox..... ever since its introduction into Europe, more than a thousand years ago, has descended with undiminished violence from generation to generation.’

And Dr. Lettsom of London, in 1801 wrote: ‘In reflecting upon its ravages the mind revolts with horror.’

CHAPTER II.

SMALL-POX IN THE EIGHTEENTH CENTURY.

Our chief authorities are Süssmilch, Juncker, De la Condamine, Duvillard, Bernouilli and some others.

Süssmilch was a celebrated statistician of the time of Frederick II. of Prussia and a member of the Prussian Royal Academy of Sciences. His work 'Die göttliche Ordnung'—The Divine Dispensation—appeared in 1741 and the fourth edition (1775-6) gives much valuable information in the third part, in fact it initiated the science of statistics in Germany.

Dr. Juncker was a professor in Halle; his 'Archiv der Aertzte and Seelsorger wider die Pockennoth' first appeared in 1796; six numbers were published before the end of 1798.

De la Condamine was the learned champion of inoculation in France though an unsuccessful one. Bernouilli, the mathematician, wrote a handbook on popular statistics. Duvillard's work—'Analyse et Tableau de l'influence de la Petite Vérole sur la Mortalité à chaque age.....' Paris, 1806—contains the Geneva table amongst others.

The Reports of the recent Royal Commission are replete with information—the appendix to the first volume contains Simon's 'Papers' of 1857.

GENEVA, 1580-1760. (Duvillard).

Small-pox deaths at various ages:—**25,349 deaths.**

	Years.			
6,792	in age-class 0-1	= 26·8	per cent. of the total.	
5,416	"	1-2 = 21·4	"	"
4,116	"	2-3 = 16·2	"	"
2,826	"	3-4 = 11·1	"	"
1,928	"	4-5 = 7·6	"	"
1,325	"	5-6 = 5·2	"	"
944	"	6-7 = 3·7	"	"
543	"	7-8 = 2·5	"	"
454	"	8-9 = 1·8	"	"
345	"	9-10 = 1·4	"	"
267	"	10-15 = 1·0	"	"
141	"	15-20 = 0·6	"	"
87	"	20-25 = 0·3	"	"
48	"	25-30 = 0·2	"	"
17	"	above 30 = 0·1	"	"

(Footnote by Duvillard—‘.....Except the facts regarding the mortality of Geneva, which have been extracted from the mortuary registers of that town by the late Dr. Cramer, and which have been forwarded to me by Dr. Butini.’)

Thus nearly half the total small-pox deaths occurred in the age-class under two years, more than four-fifths under five years, and 96 per cent. under ten years.

COPENHAGEN, 1750-1800. (Small-pox deaths).

Returns furnished at request of British Government in 1857.

1750-60.	1761-70.	1771-80.	1781-90.	1791-1800.
1,457	4	8	174	297
80	7	22	332	155
113	167	190	123	139
53	480	116	77	452
9	138	276	427	248
1,117	42	86	193	357
125	6	7	136	423
13	27	278	185	386
13	1,219	283	323	54
1,079	22	98	140	35
118				

Total 12,309; total deaths from all causes 173,080; ratio 1 : 14.

The population of Copenhagen in 1750 was 60,000 ; (1769) 70,495 ; (1796) 83,604. Thus the average small-pox rate during the whole period was **about 3,500 per million living** in Copenhagen, for the half century previous to the introduction of vaccination. During the first half of the above period the rate was about 4,000 yearly, and this lends strong support to Dr. Farr's estimate for London during the eighteenth century, viz., an average rate of above 4,000 small-pox deaths yearly per million of population.

(To show the ravages of small-pox in an unprotected population :—in 1707 this disease killed 18,000 out of a total population of 50,000 in Iceland).

SWEDEN, 1774-1798. (Siljestrom).

Yearly average of small-pox deaths at various ages:—

	Under 1 year.	1-3.	3-5.	5-10.	All ages.
Average—	1,137	1,233	870	585	4,131

Thus, on an average nearly four-fifths of the deaths occurred under 5, and nine-tenths under 10 years.

The most important pre-vaccination statistics are those of Sweden.

SWEDEN. Before Vaccination.

Year.	Population.	Total Deaths.	Small-pox Deaths.	Per Million living.
1774	2,001,360	43,609	2,065	1,032
1775	2,020,847	49,560	1,275	631
1776	2,040,334	45,692	1,503	737
1777	2,059,821	51,096	1,943	943
1778	2,079,308	55,028	6,607	3,177
1779	2,098,795	59,365	15,102	7,196
1780	2,118,281	45,731	3,374	1,593
1781	2,123,080	54,313	1,485	699

Year.	Population.	Total Deaths.	Small-pox Deaths.	Per Million living.
1782	2,127,879	58,247	2,482	1,166
1783	2,132,678	60,213	3,915	1,836
1784	2,137,477	63,792	12,456	5,826
1785	2,142,275	60,770	5,077	2,370
1786	2,143,919	55,951	671	313
1787	2,145,563	51,998	1,771	825
1788	2,147,207	57,320	5,462	2,544
1789	2,148,151	69,583	6,764	3,148
1790	2,150,493	63,598	5,893	2,740
1791	2,176,483	55,946	3,101	1,425
1792	2,202,473	52,958	1,939	880
1793	2,228,463	54,376	2,103	944
1794	2,254,453	53,362	3,964	1,758
1795	2,280,441	63,604	6,740	2,956
1796	2,293,813	56,454	4,503	1,963
1797	2,307,185	55,030	1,733	751
1798	2,320,557	53,866	1,357	585
1799	2,333,929	59,192	3,756	1,609
1800	2,347,303	73,928	12,032	5,126
Period 1774-1800		1,524,602	119,073	Average 2,049

The above figures are those furnished to the German Imperial Health Office, after careful revision, by the Swedish Statistical Bureau, and thus we learn that the small-pox deaths during the above period average **2,049** yearly per million living.

The following figures are taken from 'Mortality of the Metropolis' by J. Marshall, London, 1832, as cited by Dr. W. A. Guy, F.R.S., in his paper 'On 250 Years of Small-pox in London,' published in the *Journal of the Statistical Society of London*, vol. xlv. (1882).

LONDON. *Seventeenth Century.*

(Deaths from small-pox).

The returns are not official, but are derived from the Registers of the Parish burials; 10 years are wanting, 1637-46, and

*the deaths from all causes are not given for the period 1647-1660. The deaths are described as 'flox and small-pox' from 1629-1686 inclusive, and as 'flox, small-pox and measles' from 1687-1700. 'Flox' (= flux) was a peculiar form of small-pox (Guy).**

	1629- 1636.	1647- 1660.	1661- 1670.	1671- 1680.	1681- 1690.	1691- 1700.
	72	139	1,246	696	2,982	1,241
	40	401	768	1,116	1,408	1,592
	58	1,190	411	853	2,096	1,164
	531	184	1,233	2,507	1,560	1,683
	72	525	655	997	2,496	784
	1,354	1,279	38	359	1,062	196
	293	139	1,196	1,678	1,551	634
	127	832	1,987	1,798	1,318	1,813
		1,294	951	1,967	1,389	890
		823	1,465	689	778	1,031
		835				
		409				
		1,523				
		354				
Small-pox	2,547	9,927	9,950	12,660	16,640	11,028
All Causes (89,995)	—	—	(241,317)	(191,168)	(223,606)	(207,704)

King's estimate for the population in **1685** is 530,000. The *Companion to the Almanack* (1828) gives for London for the year **1750** a population of 653,900. In **1801** the population 'within the Bills' was 746,233 by census (the first). Thus we may fairly assume that the deaths per million living were about 3,000 yearly in the decade 1681-90, and about 2,000 yearly in the decade 1691-1700. But these are only rough estimates.

* The deaths from all causes in the decade 1661-70 are given in Dr. Guy's paper as follows: (1661) 16,655, (1662) 13,664, (1663) 12,741, (1664) 15,453, (1665) 97,306, (1666) 12,738, (1667) 15,842, (1668) 17,278, (1669) 19,432, (1670) 20,198. The year 1665 was the year of the Great Plague, which caused 68,596 deaths in London.

LONDON. Small-pox deaths in each year of the eighteenth century.

("SMALL-POX" ALONE).

Period	1701- 1710.	1711- 1720.	1721- 1730.	1731- 1740.	1741- 1750.	1751- 1760.	1761- 1770.	1771- 1780.	1781- 1790.	1791- 1800.
	1,099 311 398 1,501 1,095 721 1,078 1,687 1,024 3,138	915 1,943 1,614 2,810 1,057 2,427 2,211 1,884 3,229 1,442	2,375 2,167 3,271 1,227 3,188 1,569 2,379 2,105 2,849 1,914	2,640 1,197 1,370 2,688 1,594 3,014 2,084 1,590 1,690 2,725	1,977 1,429 2,029 1,633 1,206 3,236 1,380 1,789 2,625 1,229	998 3,538 774 2,359 1,998 1,608 3,296 1,273 2,596 2,181	1,525 2,743 3,582 2,382 2,498 2,334 2,188 3,028 1,958 1,986	1,660 3,992 1,039 2,479 2,669 1,728 2,567 1,425 2,493 871	3,500 636 1,550 1,759 1,999 1,210 2,418 1,101 2,077 1,617	1,747 1,568 2,382 1,913 1,040 3,548 522 2,237 1,111 2,409
Totals	12,052	19,532	23,044	20,592	18,533	20,611	24,234	20,923	17,867	18,477
All Causes . (214,611)	(239,115)	(274,922)	(264,925)	(252,717)	(204,597)	(234,412)	(214,605)	(192,690)	(196,801)	
Proportion about	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{6}$	over $\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{4}$

Thus (1) small-pox caused about one-twelfth of all deaths in London in the eighteenth century; (2) there is less small-pox mortality towards the end, than in the middle of the century; (3) the table does not include suburban burials, but only the church burials in London.

GLASGOW. (End of eighteenth century. Deaths).

Year.	All Causes.	Small-pox.	Year.	All Causes.	Small-pox.
1783	1,413	155	1791	2,146	607
1784	1,623	425	1792	1,848	202
1785	1,552	218	1793	2,045	389
1786	1,622	348	1794	1,445	235
1787	1,802	410	1795	1,901	402
1788	1,982	399	1796	1,369	177
1789	1,753	366	1797	1,662	354
1790	1,866	336	1798	1,603	309
			1799	1,906	370
			1800	1,550	257
<hr/>			<hr/>		
	13,613	2,657		17,475	3,302

Total deaths, **31,088**. Small-pox deaths, **5,959**. Proportion, **19** per cent. (nearly one-fifth).

We can hardly believe our eyes when we read the figures, and yet we are informed by learned opponents of vaccination that small-pox was formerly 'a mild disease.' Let no man ever say so again.

Villages were sometimes ten or fifteen years without an epidemic, *e.g.*, Ackworth in Yorkshire. In the decade 1747-1756 there were 127 baptisms and 107 deaths—one death by small-pox; in the next decade 212 baptisms and 156 deaths—13 by small-pox.

KILMARNOCK (1728-63).

The 622 small-pox deaths constituted one-sixth of all deaths (Dr. M'Vail), and the following are the deaths arranged in age classes, showing that in the era before vaccination the mortality was almost exclusively confined to children.

Under 1 year, 118; 1-2, 146; 2-3, 136; 3-4, 101; 4-5, 62; 5-6, 23; above 6, 27; age unknown, 9. Total 622.

LIVERPOOL (3 years 1772-4).

Population, 34,407; baptisms, 3,559; burials, 3,634. Small-pox deaths, 662 (nearly one-sixth of all deaths).

The following figures respecting Berlin and Leipsig are given by Süssmilch (1775), who had previously studied the London figures carefully. He derived his information from the Government and the Church registers, and Baumann (1787) edited the statistical part after the death of Süssmilch.

BERLIN (1758-74). (Small-pox deaths, Süssmilch).

Years.	All deaths.	Small-pox deaths.	
		Total.	Above 15 years.
1758	5,544	224	2
1759	4,469	585	3
1760	4,125	363	1
1761	3,924	304	1
1762	4,845	449	5
1763	4,956	351	3
1764	3,526	32	2
1765	3,715	47	0
1766	4,653	1,060	10
1767	3,814	331	4
1768	4,266	39	0
1769	4,016	359	5
1770	5,123	987	2
1771	6,049	227	1
1772	8,501	302	1
1773	5,206	664	3
1774	4,401	381	2
<hr/>		<hr/>	
17 years.	81,133	6,705	45
	B	A	

Above 15 years, 1 in 149.

$\frac{A}{B}$ = nearly one-twelfth.

As before, the mortality is almost entirely amongst the young.

LEIPSIG (1759-74).

1759-65.	1766-74.
0	41
263	95
32	34
0	94
9	18
25	8
7	201
	105
	6
<hr/> 336	<hr/> 602

$$\frac{\text{Small-pox deaths}}{\text{All deaths}} = \frac{938}{22,475} = \text{one twenty-fourth nearly.}$$

BERLIN (1783-1800). (Small-pox deaths, Juncker).

Small-pox deaths. 1783-91.	All deaths.	Small-pox deaths. 1792-1800.	All deaths.
692 } 1,083 (= $\frac{1}{13}$ of) 14,994		698 } 1,311 (= $\frac{1}{12}$ of) 15,950	
340 }		545 }	
51 }		68 }	
1,077 } 1,428 (= $\frac{1}{11}$ of) 16,120		932 }	
298 }		463 }	
53 }		26 }	
914 } 1,804 (= $\frac{1}{9}$ of) 16,253		133 }	
814 }		359 }	
76 }		129 }	

Total small-pox deaths, 7,668. Total deaths, 98,643.

Ratio, **one-thirteenth.**

In the year 1796 there was a severe small-pox epidemic in Germany. In 10 Prussian Departments the small-pox deaths were 12,405, and the total deaths 75,424; ratio nearly $\frac{1}{6}$ (as in Glasgow).

In the same year there were **817** deaths in the county of Wernigerode, and of these **only one occurred in**

the age-class above 15 years: (0-1) 130, (1-2) 106, (2-3) 91, (3-6) 301, (6-10) 159, (11-15) 29, (16-20) 1; total 817 (Juncker).

Dr. Farr's estimate for London was about **4,000** in the 18th century, as the average small-pox rate per million.

Sir Lyon Playfair's estimate for all England was at least **3,000** deaths per million living, on an average, and the reader must bear in mind that a good many of those who survived were left pitted, or scarred, or blind, or all three together.

Small-pox was mainly a disease of children in former times, and the adult population consisted for the most part of the survivors from an attack in childhood, therefore **permanently** protected.

The disease was regarded as universal, or almost universal.

Dr. Lettsom wrote that most children in London had small-pox before the seventh year of life.

In Chester, in 1775, after an epidemic of small-pox, of 14,713 inhabitants only 1,060 (= 7 per cent.) had **not** had small-pox (C. E. Paget). Here the cases were 1,385 with 202 deaths (180 under 5 years) **all under 10** years of age.

In Hastings (1730-31) there were 705 attacks in a population of 1,636; of the remaining **931** no less than **725** were survivors from previous attacks.

Out of **1250** cases of small-pox in three Prussian towns in the year 1796, the age-class under 10 years furnished **1,184**, *i.e.*, 94·5 per cent. The collective population was 13,329, and out of the **12,079** not attacked in 1796, all but **524** were survivors from previous epidemics (Juncker's 'Archiv.') (See also Geneva and Kilmarnock figures).

About one-sixth or one-eighth of the attacks were fatal (one-third in young children, Bernouilli). This is the estimate of the 'k. k. Gesundheitsamt,' Berlin, with these examples:—Of the 1,250 cases above cited 199 died, *i.e.* about $\frac{1}{6}$.

Hastings (1730-31) 97 out of 705 died, *i.e.* about $\frac{1}{7}$.

Chester (1775)—above mentioned—nearly $\frac{1}{6}$ died.

London small-pox hospital (1777) a fourth died (125 out of 497); in 1796 **a third** (148 out of 447); in 1781 **two-fifths** (257 out of 646)!

Jurin showed from the London Death Register that every 14th child born died of small-pox, and that every fifth or sixth case was fatal (16 to 20 per cent. fatality). But there is enough evidence apart from Jurin.

The disease was endemic in large cities, but epidemics visited the small towns and villages every few years (see Boston epidemics, p. 23), and few 'liable' persons escaped infection. As examples: in the village of Christleton (Cheshire) in the year 1778, of **107** children not survivors from small-pox, **100** were attacked (Creighton).

In Oldenburg (1795) **out of 600 children** not survivors, **550 were attacked** and 144 died (26 per cent.). (Kussmaul).

About one-twelfth of the total mortality from all causes was due to small-pox. This enormous proportion may well astonish the reader, but the Tables given prove it. In London (1721-1796) of 1,759,298 deaths from all causes, 158,002, *i.e.* about **one-eleventh**, were small-pox deaths (average of century **one-twelfth**).

Sometimes the proportion was lower ($\frac{1}{20}$ to $\frac{1}{12}$), sometimes much higher.

In Berlin (1758-1772 and 1785-1799) of 30,811 deaths, 2,548, *i.e.* about **one-twelfth**, were due to small-pox (Guttstadt).

In Leipzig (1764-74) the proportion was about **one-twentieth** (Süssmilch); in Edinburgh (1744-63) nearly **one-tenth**; in Glasgow (1795-1800) nearly **one-fifth**!

The age-class under ten years furnished nearly all the deaths. In Berlin (1758-1774) out of 6,705 small-pox deaths, 5,876 were of children under 5, and 742 of children aged 5-10 years; thus nearly 99 per cent. were under 10 years (Süssmilch).

In Manchester (1769-74) the total deaths by small-pox were 589, of these **559** belonged to children under 5 years (Juncker).

Warrington in 1781 showed 209 small-pox deaths; 197 were in age-class under 5 years, and no person that died was older than 20 years.

In Kilmarnock (1728-63) small-pox caused a sixth of all deaths, and of the 622 deaths by small-pox, all but 27 were in age-class under 6 years (M'Vail). (See Table given).

From the preceding figures and from the Tables, the reader will grasp the fact that in the pre-vaccination era **the loss of life by small-pox was enormous.** Juncker estimated that 400,000 small-pox deaths occurred yearly in Europe on an average, and that five-sixths of mankind were attacked. Many writers were of opinion that **everyone was attacked sooner or later** (Rhazes the Arabian physician, De la Condamine, Hildebrandt, &c.). King Frederick William III. of Prussia in a despatch dated October 31, 1803, states that small-pox caused on an average **40,000 deaths yearly in Prussia.**

The Prussian Statistical Bureau states the population in **1804** as 10,023,900. Thus the rate per million was above **4,000** yearly in the pre-vaccination era, according to the King's estimate, founded on the Report of the Medical College.

De la Condamine said in his work in 1754 ('*Mémoire sur l'inoculation de la petite vérole*'), that every tenth death was due to small-pox, and that one-fourth of mankind were either killed by it, or crippled or disfigured for life. The disease was 'a river that everyone had to cross.'

The following are the deaths year by year due to small-pox in Boston, Lincs., during the second half of the 18th century; they show a remarkable regularity of epidemics of small-pox (Creighton).

In 1749 there were 48 deaths, in 1750 none.

BOSTON, Lincs. (Small-pox Deaths.)

1751-60. 1761-70. 1771-80. 1781-90. 1791-1800.

0	0	2	19	2
0	3	6	0	0
0	69	27	0	1
1	5	0	58	0
19	0	55	4	1
34	0	7	0	64
4	0	6	0	0
4	0	18	0	0
0	3	3	27	0
2	78	0	0	1

CHAPTER III.

INOCULATION OF SMALL-POX.

'THE Philosophical Transactions of the Royal Society,' 1714, contain a letter from Dr. Timoni of Constantinople to Prof. Woodward describing inoculation, and stating that the Circassians had introduced the practice about 40 years previously into Constantinople, and that severe cases were rare. Greek women inoculated and used matter from an early vesicle (the mother-pustule of Jenner), before the contents had become purulent.

In 1715, Dr. Peter Kennedy, who had travelled in the East, describes the practice in his work, 'An Essay on External Remedies.'

In 1716, Sir Hans Sloane published a report of Dr. Pylarini, already published in Venice. The latter had practised in Constantinople, and agrees with the previous writers in saying that the disease thus imparted was usually very mild.

In 1717, the witty and charming Lady Mary Wortley Montague, wife of the British Ambassador in Turkey, wrote to her friend Miss Sarah Chiswell (Letter 31 of 1789 edition, to 'Mrs.' S. C.).

Adrianople, *April 1, (1717) O.S.*

To Mrs. S. C.

' Apropos of distempers, I am going to tell you a thing, that will make you wish yourself here. The small-pox, so fatal and so general amongst us, is here entirely harmless by the invention of engrafting, which is the term they give it. There is a

set of old women who make it their business to perform the operation, every autumn in the month of September, when the great heat is abated. People send to each other to know if any of their family has a mind to have the small-pox; they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nutshell full of the matter of the best sort of small-pox and asks what vein you please to have opened. She immediately rips open that you offer to her, with a large needle (which gives no more pain than a common scratch) and puts into the vein as much matter as can lie upon the head of her needle, and after that, bind up the little wound with a hollow bit of shell, and in this manner opens four or five veins. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have very rarely above twenty or thirty on their faces (*sic*), which never mark, and in eight days' time they are as well as before their illness. Where they are wounded, there remains running sores during the distemper, which I don't doubt is a great relief to it. Every year thousands undergo this operation, and the French Ambassador says pleasantly, that they take the small-pox here by way of diversion, as they take the waters in other countries. There is no example of anyone that has died of it, and you may believe I am well satisfied of the safety of this experiment since I intend to try it on my dear little son. I am patriot enough to take pains to bring this useful invention into fashion in England, and I should not fail to write to some of our doctors very particularly about it, if I knew any one of them that I thought had virtue enough to destroy such a considerable branch of their revenue, for the good of mankind. But that distemper is too beneficial to them, not to expose to all their resentment, the hardy wight that should undertake to put an end to it. Perhaps if I live to return, I may, however, have courage to war with them. Upon this occasion, admire the heroism in the heart of

Your friend &c., &c.'

The 'opening the vein' meant really making a few scratches or a slight puncture or two.

Dr. Maitland, attached to the Embassy, in 1718,

supervised the inoculation of the dear little son (who did well) and in 1721 came to London and inoculated this child's sister in London and then Dr. Keith's son, and at the King's command six criminals condemned to death, who did well and were presented with their lives. One of them had had small-pox already, and no result followed the inoculation. Also a young woman, condemned to death, was inoculated in the Chinese way, by introducing small-pox crusts into the nose; she had severe headache, and sharp fever, but did well, and earned her pardon also. In 1729, Jurin reports 897 inoculations up to that time with 17 deaths (2 per cent.)—in Scotland, a death amongst the first ten inoculated had stopped the practice; and in Ireland, 3 out of 10 died. Inoculation after this went out of use till 1840, when it was revived, from America.

By the year 1768, in the London 'stations,' for the purpose, only 6,581 persons had been 'inoculated.' Towards the end of the century it came into more general use amongst the richest classes, to which it was chiefly confined. It owed its chief extension to a quack, Daniel Sutton, who proposed to inoculate people very mildly, and charged high fees. During 1764-66 Sutton and his assistants inoculated 20,000 persons. Sometimes no general eruption followed, but Sutton was pleased to declare that his clients were 'protected,' if merely local symptoms followed inoculation.

Abroad the practice was favoured by various sovereigns; the Empress Maria Theresa, Frederick the Great, Catherine II. of Russia, and by princes and potentates. Catherine II. was inoculated by Dr. Dimsdale of London, an ancestor of the present Lord Mayor of London. In France, De la Condamine

(1754) championed the cause in vain. The medical faculty of Paris pronounced against inoculation at an early date.

But inoculation never became popular on the Continent, as we learn from Goethe, who was in favour of it himself. 'The inoculation of small-pox was always regarded as very problematical, and although popular writers warmly recommended it, yet German surgeons hesitated to adopt a procedure which seemed to anticipate Nature.....'—'Dichtung u. Wahrheit.' In Juncker's 'Archiv.' a letter from Dr. Hussty of Pressburg informs us that no inoculation had been made there for over twenty years:—'The so-called great go with their children to Vienna to be inoculated, the middle classes are still too prejudiced against it.'

The deaths were estimated at about 1 in 300 inoculations (*Denkschrift* of the Gesundheitsamt.); but the proportion seems to have been somewhat higher than this. In Denmark, however, Callisen inoculated 900 persons in the middle of the century without one death, the Crown Prince amongst them, but in 1760 some inoculation hospitals in Copenhagen were closed, as no one attended for inoculation.

In East Friesland the proportion of deaths was 5 in a total of 460. Jurin's report of 2 per cent. deaths in England has been mentioned.

The disease was certainly milder when directly inoculated into the skin, than when it occurred by natural infection. But there was always the risk of starting fresh epidemics by it. In England we do not read of such, but abroad we read of several:—

1788. Weimar, reported by Hufeland.

1794. Hamburg, reported by Wolff.

1795. Berlin, ascribed by Formey to inoculation.

There is no evidence that inoculation increased small-pox mortality as a whole, towards the end of the century. Epidemics crowded close upon each other, whether inoculations were practised or not. In Berlin inoculation began very late; in Copenhagen, in Sweden, and in France, it never was popular. Heberden (1801) said that the small-pox deaths in London were 7·4 per cent. of the total deaths in the first 30 years, 9·5 per cent. in the last 30 years of the century. The actual deaths by small-pox in London *were fewer towards the end, than in the middle of the century*, although the population was increasing.

It is necessary to dwell upon the extent of the spread of inoculation in various countries, because some opponents of vaccination first exaggerate the amount of inoculation, then exaggerate the small-pox mortality at the end of the century, and ascribe this assumed increase to inoculation, and lastly ascribe the sudden lowering of that mortality which, as we shall find, ensued directly upon the introduction of vaccination, to the discontinuance of inoculation!

The procedure rests upon error. There was in London a slight increase of small-pox mortality in the very last decade of the 18th century, as compared with the decade before it, but the increase is in any case inappreciable (when we consider that the population was increasing too) as compared with the decline after vaccination.

Further, inoculation did not suddenly cease, but went on for years after vaccination began.

Lastly, the practice was never popular in Sweden, in fact hardly anywhere on the Continent.

We must mention here *Dr. Haygarth's plan* 'to exterminate the small-pox.'

In 1784, Haygarth said to the people of Chester—Do two things:—

(1) Inoculate everybody (by inoculations carried out every second year).

(2) Isolate each case of small-pox as it arises.

But Haygarth held three erroneous notions about small-pox.

(a) That clothing could not convey the contagion, unless directly smeared with pustular contents.

(b) That there was no risk of infection till the eruption appeared.

(c) That the disease was only contagious for about 18 inches, hence he would have considered a case isolated if the patient was placed in an adjoining apartment!

In 1793 Haygarth published a second paper advocating his plan for all England. 'It was fortunate for the future of isolation that they (Haygarth's recommendations) were not adopted' (M'Vail). His plan failed in Chester itself, it was not Jenner's publication that killed it. It died a natural death. Haygarth wanted to abolish small-pox by giving it to everybody.

In 1796 he wrote to warn Jenner against any premature and insufficiently grounded publication. A man who had thought and observed for twenty years on one subject did not want this warning.

Bryce's Test. Sometimes a second inoculation of small-pox lymph was made three or four days after the first, to *test* the success of the first. If the second vesicle (*i.e.* from the second insertion) *quickly* developed, so as to reach maturity at the same time as the first, it shewed that the system was already under the influence of the

first. The same procedure was recommended by Jenner for vaccination in 1807; it is known as 'Bryce's Test.'

SECOND ATTACKS OF SMALL-POX IN THE SAME PERSON.

Can the same person have small-pox twice, with an interval of some years between the attacks? Yes; but such cases, fully established, are very rare. The frequency of such second attacks in former times is suspicious, because measles was often mistaken for variola, to say nothing of various kinds of 'false small-pox,' *e.g.*, varicella (chicken-pox).

Reinfection no doubt occurred to some extent in the examples given by Sarcone, Huxham, and Juncker, in which suckling mothers and nurses, who had had small-pox, saw local small-pox pustules develop about the breast and neck, where the child's head lay, when nursing infants with small-pox upon them. But on the other hand Juncker distinctly says that it was a rare thing for the same man to suffer more than once really and generally. This is supported by the fact that the mortality fell almost wholly upon the youngest class. Dr. Kübler, a high modern authority on the point, which he has carefully studied and made the subject of a special work 'Ueber die Dauer...' (Arbeiten aus dem Kaiserlichen Gesundheitsamte, Bd. xiv.), says that '*The once-survival of small-pox afforded perhaps no perfect protection, but still a strong resistance against a fresh attack.*'

The German Vaccination Commission of 1884 debated well this point. Dr. Koch said that second attacks were certainly rare; in the great epidemic (1871-2) in **12,000** cases in South Germany, **no second attack** occurred. Dr. Reissner pointed out that in old times, *all second*

attacks appear to have occurred in children, never in adults; this pointed to error in diagnosis. Dr. Grossheim who represented the Army, had only met with one peculiar case out of **22,641** in military hospitals; a man had a light form of variola *three months* after the first attack.

Von Kerchensteiner (for Bavaria) had never heard of an *early* second attack. But he believed in the occurrence of second attacks, and he himself had seen a *third* attack. Prof. Hebra, of Vienna, had treated the patient in the first two attacks; he died in the third.

Dr. Krieger had seen one certain second attack in 500 cases of small-pox observed by himself. Dr. Thierfelder had never heard of, or seen, a second attack.

Dr. von Koch (to be distinguished from Dr. Robert Koch) had met with two in Stuttgart, both fatal, in each case the second attack was many years after the first—‘a long interval of time.’

Dr. Siegel stated that *Wunderlich* found 22 second attacks in 1727 cases in Leipsig in 1781, six were fatal, and one of these six patients had had small-pox already *in the same epidemic*. *Wunderlich* was ‘a reliable and exact observer,’ but the interest which this case had aroused showed that it was a very rare exception.

It is said that Louis XV. of France died in a second attack, having gone through the first in childhood (‘a light form’), but the reader will have his doubts. The ‘light form’ may have been chicken-pox. The statements of patients as to attacks in childhood are usually worthless. But second attacks do occur, as the Final Report of the Royal Commission (1896) shows. The Epidemiological Society reports 200 cases, 8 per cent. fatal.

ORDER OF EVENTS IN INOCULATION.

Second or third day, local inflammation; 4th, vesicle; 6th, pain in axilla, and glands enlarge; 7th or 8th day, *fever* sets in—('the *eruptive* fever'—the main sign that the system was by now affected), lasting two or three days till, 10th or 11th day, the general eruption; 13th or 14th, vesicles become pustules, and the *secondary fever* sets in.

CHAPTER IV.

THE INTRODUCTION OF VACCINATION. EDWARD JENNER.

Cow-pox is a specific eruptive disease of cows, usually attended with sores on the udders; its etiology will be considered in a subsequent chapter.

Further, cow-pox runs a regular course, and can be imparted to man as is done in vaccination. (The term 'Inoculation' is here reserved to mean the operation of imparting small-pox, now illegal).

That cow-pox when accidentally imparted to milkers conferred upon them protection against small-pox, was a tradition in England and in many other countries, long before Jenner's time. Humboldt heard of it in Mexico (see 'Travels,' pub. 1803), Bruce in Beluchistan.

In England, the tradition was popular in a great many parts of the country, and Dr. Fewster of Gloucestershire in 1765 sent a paper to the Medical Society of London, to the effect that 'inoculation' failed in persons who had been infected by cow-pox. Fewster seems to have pursued the subject no further, though he afterwards met Jenner, and knew his views. Also, Dr. Rolph of Gloucestershire subsequently stated that no experienced medical man was unaware of the tradition as reported by Fewster.

In 1774, a farmer, Benjamin Jesty of Dorsetshire, *vaccinated his wife and two sons*. All three resisted small-pox infection during subsequent epidemics, and fifteen years afterwards one of the sons was 'inoculated' without result, thus proving that he was protected. But the procedure in this case was dropped, because Mrs. Jesty had suffered from a severe inflammation of the arm after vaccination.

Prof. Esmarch forwarded to Dr. Kübler the exact words from the 'Allegemeinen Unterhaltungen vom Jahre,' 1769, preserved in the Göttingen University Library, in which Jobst Böse, a bailiff, speaks of having heard the tradition himself ('Mehrmaßen von gar reputirlichen Personen') 'often from reliable persons' (Kübler, 'Gesch. der Pocken und der Impfung,' 1901).

In Holstein, a farmer (Jensen), also a teacher (Plett) *vaccinated from the cow in 1791*. The three children vaccinated by Plett resisted small-pox infection in 1794, when their unvaccinated sisters had small-pox, but unluckily Plett had chosen the back of the hand, between the thumb and index-finger, as the site of vaccination, and a sharp inflammation of the arm had followed in one of his cases; hence he did not pursue the practice.

The tradition was known also in Italy, in the South of France, in Holland, and elsewhere.

Thus all these vaccinations came to nothing, and would never have been heard of but for Jenner's introduction of the practice into general use.

EDWARD JENNER, 1749-1823,

Was born at Berkeley in Gloucestershire, the son of a clergyman. At the early age of eight years he was 'inoculated' with small-pox, and, as a preparation, was bled, and purged, and starved, and afterwards nearly killed by the disease. The impression of small-pox was thus a profound one. After attending school at Wotton-under-Edge, he became first an apprentice under a surgeon, Daniel Ludlow in Sodbury, near Bristol, and then a house-pupil of John Hunter in London, 1770. Here he learnt to observe, and to draw conclusions from his observations, and to act on them. While still an apprentice in Sodbury he had heard a peasant woman telling his master that *she could not take the small-pox because she had already had the cow-pox*. This deter-

mined Jenner to learn more about this subject, and was the starting point of his career of fame. In 1771, Jenner undertook with zeal the arrangement of the objects of natural history (brought by Sir J. Banks) from Cook's first voyage. Several Zootomical 'Papers' by Jenner were inserted in the 'Philosophical Transactions.'

Jenner declined an invitation to go with Cook on his second voyage, and in 1772 settled in practice near his home. But he constantly corresponded with Hunter, and undertook investigations at his suggestion. In 1788, a paper 'On the Natural History of the Cuckoo,' amongst other publications, won him the Fellowship of the Royal Society, an honour now perhaps more difficult to obtain, but Jenner had the powerful support of John Hunter. The subject of cow-pox had never left Jenner's mind, and in 1780 he mentioned his ideas to his friend Gardner. He was very active both professionally and scientifically, and declined a flattering invitation from Hunter to teach and lecture in his new School of Natural Sciences in London. In 1787 Jenner spoke to his nephew George Jenner about the connection between horse-pox and cow-pox. By continued observations, Jenner in 1788, the year of his marriage with Katherine Kingscote, arrived at the definite conviction that the popular tradition about cow-pox was correct, and the same year he took a drawing of a cow-pox sore with him to London and showed it to Hunter and others. He had already conceived the idea of imparting cow-pox to man by inoculation (vaccination), and only waited now for a favourable case of cow-pox to present itself. In 1792 he became M.D. of St. Andrew's University. At last, after accumulating many observa-

tions on immunity against small-pox (whether 'natural' or inoculated) enjoyed by persons who had had natural cow-pox, on **May 14, 1796**, a memorable day in the history of the human race, Jenner vaccinated successfully a boy James Phipps from a sore on the hand of Sarah Nelmes, a milkmaid, who had accidentally been infected with cow-pox in milking her master's cows.

After waiting a few weeks, Jenner inoculated the same boy on both arms carefully with fresh small-pox lymph ('the Jennerian experiment'), on July 1. But the boy did not take small-pox; nothing resulted but a few slight local symptoms; the previous vaccination protected him.

The vaccination era had begun. Jenner now had to wait till early in 1798 before he could procure fresh lymph. Meanwhile in 1797 he prepared a paper for publication, containing his one case and numerous observations of immunity amongst milkers against 'inoculation.' But the Secretary of the Royal Society advised him to strengthen his case by further experiments before publishing. His first paper was not 'rejected by the Royal Society,' for it was never formally sent in. Dr. Pagel of Berlin reminds us (in the Festnummer of the *Deutsche Medicinischen Wochenschrift*, May 14, 1896, in memory of Edward Jenner) that another momentous paper was similarly declined by the editor of Poggendorff's *Annalen*, viz., that of Julius Robert Mayer, 'Bemerkungen über die Kräfte der unbelebten Natur.' By the spring of 1798 Jenner had accumulated four cases (of his own) of vaccination, tested by subsequent inoculations. He then completed his pamphlet and went up to London and published it in June, thus entitled:—'An Inquiry into the Causes and Effects of

the Variolæ Vaccinæ, a Disease Discovered in some of the Western Counties of England, particularly Gloucestershire, and Known by the Name of the Cow-Pox.

By Edward Jenner, M.D., F.R.S., &c.

Quid Nobis Certius Ipsi
Sensibus Esse Potest, Quo Vera ac Falsa Notemus.
(Lucretius).

London 1798.'

The 'Inquiry' begins with a masterly description of cow-pox, well illustrated, and we then read the observations concerning persons accidentally infected with cow-pox, who afterwards resisted small-pox, both natural and inoculated, after an interval of many years, even 25, 27, 31, and 51 years. We learn that conversely small-pox survivors are usually proof against cow-pox (Case VI.); but very exceptionally are liable to cow-pox in a modified form (Case VII.); also that exceptionally the same individual may have cow-pox several times (Case IX.); further, that cow-pox inoculated into man (vaccination) has the same protective power against small-pox as cow-pox naturally acquired; and that from the resulting vesicles, further vaccinations may be made (Case XVII.).

These personal observations finished, Jenner passes on to his theory of the origin of cow-pox from horse-pox, commonly called 'grease in the horse,' warns against the use of any but genuine cow-pox lymph, also against deep incisions, his opinion being that the true material is afforded by the skin itself and not by the blood; states in what ways vaccination is superior to inoculation, and modestly ends by hoping that others will take up the subject, at the same time intimating his own intention of continuing his researches, encouraged by the hope that vaccination may prove to be a real benefit to many.

Such is this immortal document, a model of its kind, both as regards its reliance on observed facts, and its philosophic tone. It awoke the highest interest. It was mentioned in Hufeland's *Journal des Arzneykunde*, in the same year as its publication, and was translated

into German in 1799 by Ballhorn, at Strohmeyer's suggestion; into Latin by A. Careno, Vienna, 1799; into French by De la Rocque, Lyons, 1800; into Dutch, by Davids, Haarlem, 1801; into Italian by L. Careno, Pavia, 1808 (Dr. Pagel, Berlin).

Great minds are quick to meet greatness in others. Cuvier thus nobly expressed himself:—‘Quand la découverte de la vaccine serait la seule que la médecine eût obtenue dans la période actuelle, elle suffirait pour illustrer à jamais notre époque dans l’histoire des sciences, comme pour immortalizer le nom de Jenner, en lui assignant une place eminente parmi les principaux bienfaiteurs de l’humanité.’

And the equally great Blumenbach was no less prompt and eloquent in recognition, when he wrote in 1801 to thank Jenner for his pamphlet.

Jenner's merit is two-fold. A man of high culture and trained by John Hunter in scientific methods, he not only *verified his hypothesis for himself by actual experiments and abundant observations*, but foresaw the large scope—all humanity—of his theory, and with equal ardour *forced it upon the attention of the world*. The latter was perhaps more difficult to effect than the former. Jenner is one of the chief glories of the English nation, though his own country was behind other nations, including distant Japan, in celebration of the centenary of his first vaccination. Jenner did not ‘discover’ vaccination; he ‘introduced’ it.

For some three months Jenner waited in vain in London to hear if some one else had repeated his experiment, and it was not till after his return to Berkeley that, to his great satisfaction, he heard from Cline, a surgeon in London and a student friend.

Cline had vaccinated a boy with hip-disease, on the hip as a sort of counter-irritant with lymph left by Jenner, and soon afterwards had inoculated the boy with small-pox, and the boy had resisted the infection. The original stock of lymph now ran out, Cline having failed to propagate it, but in November Jenner obtained a fresh supply for a time.

Dr. G. Pearson of London, Physician to St. George's Hospital (*not* the Small-pox Hospital), whose interest was roused by the pamphlet, at once set about making enquiries on the subject by letter, and before the end of the year 1798, Pearson's 'Inquiry Concerning the History of the Cow-pox' appeared, warmly supporting Jenner. Numerous surgeons in various parts of England had reported 'insusceptibility in milkers.'

Then cow-pox was discovered in London in a dairy in Gray's Inn Lane, and Drs. Pearson and Woodville (Physician at the Small-pox Inoculation Hospital), vaccinated hundreds of children from this and other sources (a large Marylebone dairy—William's, also a Kentish Town dairy—Clarke's) during the autumn of 1798. But their first efforts cost Jenner some anxiety, for they vaccinated *at the Small-pox Hospital*, and more than half of their first 500 cases showed a general eruption! This was, of course small-pox, due to infection at the hospital, or to subsequent inoculation too early (the Jennerian test), and it is possible that in some cases the lymph was contaminated. But Woodville at first thought that a general eruption was a normal occurrence after vaccination.

April, 1799, Jenner's 'Further Observations on the Variolæ Vaccinæ, or Cow-pox' appeared. Here he distinguishes between genuine and spurious cow-pox;

makes the important statement that any injurious after-effects of vaccination (ulceration) are not due to the first action of the lymph upon the system, but are secondary phenomena which occur '*if the pustule is left to chance*'; and exposes the error of Woodville in imagining that a general eruption was natural in vaccination.

May, 1799, Woodville's 'Reports of a series of Inoculations for the Variolæ Vaccinæ or Cow-pox' appeared, containing his erroneous theory. *But this was very soon rectified, for in the very next month*, June, 1799 ('Med. and Phys. Journ.,' Vol. i., p. 417) he reports 310 more cases, of the last 110 of which *only 7 had the eruption*, and observes that he has come to '*a conclusion widely different from that of the Reports*'. So Vaccination quickly got through its first trouble.

Woodville stated that he saw no eruption when he vaccinated at private houses. Also 'the inoculated part has not ulcerated in any of the cases that have been under my care,' also that if the same person were inoculated with small-pox and cow-pox virus on the same day, one on each arm, the two diseases ran their course quite independently and characteristically. In October, 1799, Pearson published (in the 'Journal') reports from correspondents to whom he had sent threads soaked in cow-pox lymph, or rather 'vaccine lymph'—'I have not had a single case of eruption like the variolous, since that of Dr. Redfern's of Lynn'—350 vaccinations are mentioned, done by three surgeons. This makes it appear that at least some of the earliest lymph had got contaminated. In 1799 also, lymph reached America (Waterhouse), and Vienna. The first vaccinations in Vienna were made by Careno in April,

the next by De Carro in May, the latter with Pearson's lymph (per Jenner); both had good results. Heim in Berlin successfully vaccinated in 1799, and Strohmeyer in Hanover. Also Knight vaccinated two children of the Duke of Clarence; Lady Peyton undertook vaccinations herself; Lord Berkeley tested two cases. Early in 1800 the Duke of York introduced vaccination into the army, and in March, 1800, the King honoured Jenner by an audience.

Cases now multiplied rapidly all over the Country. Jenner himself had received lymph from Clarke's farm in Kentish Town, also from one of Woodville's early cases. Very little more was heard of the 'eruptions,' which only occasionally appeared.

July 1, 1800, Woodville's 'Observations' appeared with 2000 cases mentioned, '*in the hospital*, however, the disease still continues to *occasionally* produce pustules (and no wonder—author) though not more than in the proportion of 3 or 4 out of 100.' (See also Final Report of Royal Commission, 1896). Thus Woodville had quite abandoned his original view.

A large number of cases had now accumulated in many quarters, showing that vaccinated or 'cow-poxed' persons were insusceptible to small-pox, whether 'inoculated' or 'natural,' and in July, 1800, at the invitation of Dr. Ring, 73 physicians and surgeons signed a declaration in favour of vaccination, also the University of Oxford declared in its favour. March, 1801, Jenner's next work appeared 'On the Origin of the Vaccine Inoculation,' in which he stated with pride that already at least 100,000 persons had been vaccinated in England alone.

In 1802, Parliament appointed a Committee on the

subject, and on receiving its Report voted a reward of £10,000 to Jenner, not unanimously, only because the minority wished the reward to be larger. A second donation of £20,000 was made later on. To show how numerous were the tests, in 1802 Woodville informed the Committee above mentioned that up to June of that year he had vaccinated 7,500 in the Hospital 'about one-half of whom was since inoculated with small-pox, in none of whom did the small-pox produce any effect.' He further stated that general eruptions never did follow vaccination.

Jenner did not stay in London and make £10,000 a year, although urged to do so, and assured that he would do so. He preferred to go back to his country village and prosecute his researches in quiet; the acquisition of money was not to him the chief object of life. But he was a firm man, for he early declined Pearson's request to join with him in founding a Vaccine Institute, *of which Pearson was to be the head*. Soon the Royal Jennerian Institute was founded, with Jenner at the head, and in 1808 the National Vaccine Establishment, with Jenner as its first Director. In a few years he retired, and was succeeded by Moore (the author of 'The History of the Small-pox,' London, 1815).

THE RAPID SPREAD OF VACCINATION ABROAD.

As if an Angel's trumpet had sounded over the earth, thus spread the good tidings into all lands, that a preventive had been found against the horrible disease small-pox, so long the 'scourge of humanity.'

In 1799 Strohmeyer and Ballhorn began vaccinations

in Hanover, and we have mentioned America and Vienna. In 1800, vaccinations began in Greece, in the Balkans, in Turkey, in India and Ceylon, in Persia, with lymph forwarded to our Ambassadors. (Dr. Kübler details the spread over the civilised world).

In 1800 **France** sent two observers to England to report; and a vaccine station was opened in May (two publications in France had mentioned Jenner's Inquiry in 1799). In July, Woodville took to Paris fresh lymph, afterwards reported quite satisfactory. In 1801 Colon reported vaccinations made in 105 towns of France. In 1805 Napoleon ordered the vaccination of all soldiers who had not had small-pox. A Central Committee was appointed in 1804, and the vaccinations in France during 1808-11 were 368,405; 269,367; 364,016; 712,151. Germany's most distinguished physicians welcomed vaccination. The practice fairly started in Berlin in October, 1800, with lymph from the child of Jouanne, a London banker. In 1803, October 31, King Frederick William in a State paper, informs the world that the Medical College had reported **17,741** carefully observed vaccinations, of which **8,000** had been 'tested' by subsequent 'inoculation.'

1801 was the year which saw vaccination extend all over Europe. In **Italy** Sacco found a fresh source of lymph from natural cow-pox in Lombardy, and reported **8,000** successful vaccinations by September 16 of the same year! Sacco reported milder results—less tendency to ulceration—than Jenner had met with at his first trials.

In **Russia**, the Dowager Empress Maria gave the name of 'Vaccinoff' to the first vaccinated child, and sent Jenner a diamond ring and her autograph. The

Emperor Alexander spread the practice quickly all through his realm, to the farthest towns. In the ten years, 1804-14, nearly 2,000,000 persons were vaccinated, according to Körber.

Spain sent lymph to her distant colonies by a number of children in one vessel, two being vaccinated every week, to maintain an arm to arm supply.

Bavaria has the honour of being the first country in the world to make *vaccination compulsory*, in **1807**. Denmark followed in 1810, Sweden 1816, England more slowly, and took over 50 years to think about it first.

Early strong opposition. Strong language at first.

After a year or two, and especially when small-pox began to attack successfully vaccinated persons, vaccination encountered the bitterest opposition in England. A practitioner, Jones, under the pseudonym **Squirrell**—‘Observations on the Cow-pox, showing that it originates in Scrophula and is no security against the Small-pox,’ by Squirrell, London, 1805—besought people as a man of honour not to be vaccinated, and offered to clear every particle of the abomination out of the blood by means of mercury, gratis. **Rowley** issued a pamphlet ‘Cow-pox Inoculation no Security,’ London, 1803. **Moseley’s** pamphlet ‘A Treatise on the Lues Bovilla, or Cow-pox,’ London, 1805, soon reached a second edition, probably owing to the title. The abuse of vaccination was scurrilous in the highest degree; it was said that a new generation was growing up with bovine proclivities in general, and pictures were made of children with horns growing out of their heads. The theme invaded the pulpit, and ministers preached for and against vaccination. **Birch**, more temperately, later on wrote, ‘An Appeal to the Public on the Hazard and Peril of Vaccination,’ 3rd edition, 1817.

But Vaccination was long before this a world-wide acquisition, though several decades of experience were required to teach its exact value as regards the duration of its protection.

CHAPTER V.

EARLY RESULTS OF VACCINATION.

A striking and rapid fall of small-pox mortality was the immediate result of the introduction of vaccination in every country where the practice extended considerably. The conditions which then existed are not likely to recur in Europe; for the adult population was already permanently protected, speaking generally, and only the children, we may almost say only *young* children, required protection.

SWEDEN.

Vaccination began October 31, 1801, in Lund.

The Medical College reported 25,000 vaccinations by the year 1805, 23,000 in 1805, and 19,000 in 1806, using round numbers; a very rapid spread in a population of only 2,408,000 (in 1804). (The figures are official).

BEFORE VACCINATION.		VACCINATION BEGUN.			
Decade 1792-1801.		Decade 1802-11.		Decade 1812-21.	
Small-pox Deaths.	Per Million.	Small-pox Deaths.	Per Million.	Small-pox Deaths.	Per Million.
1,939	880	1,533	646	404	167
2,103	944	1,464	613	547	225
3,964	1,758	1,460	608	308	126
6,740	2,956	1,090	452	472	191
4,503	1,963	1,482	616	690*	277*
1,733	751	2,129	888	242	96
1,357	585	1,814	759	305	120
3,756	1,609	2,404	1,009	161	63
12,032	5,126	824	347	143	55
6,057	2,566	698	291	37	14
Average 1,914		Average 623		Average 133	

* Compulsory vaccination 1816.

Vaccinations.

1806-10 = 25 per cent. of births.

1811-15 = 44 " "

1816-20 = 68 " "

Thus the average rate per million living was reduced from 1,914 (it was 2,219 in the previous decade 1782-91) first to **623** and then to **133**. The low rate for a year or two after vaccination began was not due to vaccination, it was merely a remission after the high rates of 1800-1.

LONDON (1801-30).

Small-pox deaths each year, from the 'Bills of Mortality.'

	1801-10.	1811-20.	1821-30.	1831-37.
	1,461	751	508	563
	1,579	1,287	604	771
	1,202	898	774	574
	622	638	725	334
	1,685	725	1,299	863
	1,158	653	503	536
	1,297	1,051	616	{ 217 }
	1,169	421	598	{ 763* }
	1,163	712	736	
	1,198	722	627	
Small-pox	<u>12,534</u>	<u>7,856</u>	<u>8,990</u>	
	$= \frac{1}{15}$	$= \frac{1}{24}$	$= \frac{1}{80}$	
All causes	185,823	190,760	209,094	

BEFORE VACCINATION ERA.		VACCINATION ERA BEGINS.	
Decade.	Small-pox Deaths.	Decade.	Small-pox Deaths.
1761-1770	20,434	1801-1810	12,534
1771-1780	20,923	1811-1820	7,858
1781-1790	17,867	1821-1830	6,990
1791-1800	18,477		

* The Registrar-General's Returns begin in 1837 (latter part).

Thus the ratio of the small-pox deaths to the deaths from all causes sank from $\frac{1}{12}$ or $\frac{1}{11}$ in the previous century, first to $\frac{1}{18}$, then to $\frac{1}{24}$, then to $\frac{1}{30}$, although vaccination was not made compulsory. In 20 years (1811-30) the deaths only thrice exceeded 1,000.

GLASGOW. (Small-pox deaths, *Creighton*).

1791-1800—607, 202, 389, 235, 402, 177, 354, 309, 370, 257=3,302

1801-1810—245, 156, 194, 213, 56, 28, 97, 51, 159, 28=1,414

„ All deaths 23,388.

Thus the ratio sank from $\frac{1}{5}$ (nearly), to $\frac{1}{16}$.

STUTTGART.

Average of small-pox deaths yearly in each quinquennium of period 1772-1827. From the Church registers (*Cless*).

Quinquennia of period 1772-96, **224**; 1797-1801, **274**.
Succeeding quinquennia, **154, 2, 0, 10, 0** (!).

The following table is from Casper's 'Beiträge zur med. Statistik.'

Vaccination, though not made compulsory, was highly encouraged by the King, and by the year 1810 the vaccinations reached 80 per cent. of the births in Berlin (Guttstadt).

BERLIN.

Small-pox deaths (actual) during 41 years, 1782-1822.

	1782-91.	1792-1801.	1802-11.	1812-22.
	138	698	194	12
	693	545	280	8
	340	68	65	147
	52	932	947	264
	1,077	463	490	15
	298	26	100	50
	53	133	455	34
	914	359	388	15
	814	129	30	8
	76	1,646	6	1
				1
Totals	4,453	4,999	2,955	555

Before vaccination, during 1795-99, the deaths by small-pox were **6·5** per cent. of all deaths, in Berlin. After Vaccination began, the percentages during the next successive quinquennia are **7·5**, **6·4**, **0·7**, **1·3**, **0·2** (!). (*Denkschrift,—k. k. Gesundheitsamt, Berlin*).

COPENHAGEN.

Small-pox deaths. Compulsory vaccination 1810.

Vaccinations, begun in 1801, were 14·5 per cent. of births in 1802; 50 per cent. in 1805. After 1810, nearly all the children were vaccinated, for some years, vaccination being compulsory.

During 1794-1798 (before vaccination) there were **373** deaths each year on an average.

During 1799-1802 (before vaccination) **54, 35, 486, 73**, respectively.

During 1803-1810 (after vaccination) **5, 13, 5, 5, 2, 46, 5, 4**, respectively.

During 1811-1823 (after vaccination). **Not one death in 13 years.** ('Beiträge aus der Gesundheitsamte').

Thus wherever vaccination came into extensive use, there the mortality rapidly declined, *during the first two decades of the century*. It seemed as if epidemics were abolished, or about to be abolished. But this was soon altered, and vaccination had still to go through its severest crisis, before its proper use was understood, and many decades of experience were required for this.

Compulsory vaccination began early in several countries:—Bavaria, 1807; Denmark, 1810; Norway, 1811; Baden, 1815; Kurhessen, 1815; Sweden, 1816; Württemberg, 1818; Nassau, 1818; Hanover, 1821.

The first Sovereign to adopt vaccination in his own family was King Frederick William of Prussia.

Opponents of vaccination have tried to explain the very striking and rapid decline of small-pox in Sweden in the first two decades of the last century, by some other way than by vaccination.

1. It is said that the decline had already set in just before vaccination began. The Table disproves this.

2. It is said that the vaccinations were not numerous enough to account for the change. But the adult population was already permanently protected, and the children were the only liable part of the population. The vaccinations in this still susceptible part of the population were numerous enough to make a great difference

in preventing epidemic outbreaks. To repeat: in the year 1805 the Medical College reported that 25,000 vaccinations had been made up to the year 1805; the number during 1805 was 23,000; and the vaccinated percentages of the births have been already given for Sweden, see Table, showing a close *correspondence between the amount of vaccination, and the fall of small-pox mortality.*

3. Some writers ascribe that decline to the discontinuance of inoculations of small-pox. But inoculation was never popular in Sweden, even opponents of vaccination admit this, so that inoculation had nothing to do with the fall there (see p. 28).

4. It has even been said (by continental opponents) that *sheep-pox* was very prevalent in the 18th century, and suddenly abated in the beginning of the 19th, owing to severe sanitary regulations, just when vaccination was introduced. But there is no connection between sheep-pox and small-pox; Dr. R. Koch stated before the German Vaccination Commission that no case of transference had ever been established, and that the diseases were quite distinct. Further, the severe sanitary regulations affecting sheep appeared long after the decline of small-pox had set in, *e.g.*, in Stuttgart.

CHAPTER VI.

SMALL-POX IN THE VACCINATED. BEGINNING OF
REVACCINATION ERA.

VACCINATION had still to go through its severest trial.

After a couple of decades of the practice of vaccination it was found that :—

1. Epidemics of small-pox began to recur.
2. But were never so severe as in the previous century.
3. The vaccinated were attacked (this had long been noticed).
4. But the attacks were of unwonted mildness, as a rule, and deaths were rare. Hence a new disease arises—‘small-pox of the vaccinated’ (‘varioid,’ ‘horn-pox,’ &c.).
5. Small-pox is no longer ‘a disease of children,’ the ‘age incidence’ is shifted, the disease makes its appearance in the armies of Europe, and hence
6. The era of revaccination begins, at first in the armies.

The reader knows the simple explanation of these changes. The protection of vaccination had been substituted, in a large proportion of the infant population, for the more permanent protection afforded by a survived attack of small-pox, and this had sufficed to reduce the small-pox mortality very rapidly at first, because the adult population in the beginning of the century was for the most part insusceptible to small-pox. But gradually, as the protection given by once-vaccination in infancy greatly diminished with time, or

even (rarely) lapsed altogether, and as the zeal for vaccination slackened with the diminution of epidemics, and owing to this very diminution, a generation grew up, consisting partly of persons utterly unprotected against small-pox, and partly of those who were protected only partially—protected as to the vast majority against death, but not protected against attack. Hence the disease appears in vaccinated and unvaccinated young adults, and this is well shown in the third decade, in various armies formerly free from it. Even vaccinated children were attacked, but experience showed that attacks in successfully vaccinated children were rare. But vaccination still mitigated the attack, when it did not prevent it; all contemporary authors agree in this; further the tables of comparative mortality amply prove it, for where the mortality is high most of the cases were severe, and conversely, where the mortality is rare most of the cases must have been mild. The following figures prove the statements advanced.

SWEDEN.

(Recurrence of epidemics in third decade).

Small-pox deaths; actual numbers. Vaccination made compulsory, 1816.

1791-1800.	1801-10.	1811-20.	1821-30.	1831-40.
3,101	6,057	698	37	612
2,103	1,533	404	11	622
3,964	1,464	547	39	1,145*
6,740	1,460	308	618*	1,049*
4,503	1,090	472	1,243*	448
1,733	1,482	690	625	138
1,357	2,129	242	600	301
3,756	1,814	305	257	1,805*
1,2032	2,404	161	53	1,934*
	824	143	104	650

* Here we see that epidemics recur just when small pox appears

The reappearance of epidemics (but always milder than in the era before vaccination, except where vaccination was very deficient, *e.g.*, Norwich) in various cities occurred as follows (Kübler):—Edinburgh, 1817, reported by Munro and Thompson; Marseilles, 1818 (Husson); Norwich, 1819 (Cross); Genf, 1822-3 (Coindet); Berlin, 1823 (Hufeland); Copenhagen, 1824-7 (Mohl); Eckenforde, 1822 (Luders); Sweden, 1825 (Van Booch); Rotterdam, 1818 (Hodenpyl); Utrecht, 1822-4 (Turshink); Milan, 1822 (Sacco). We may add London 1817 and 1825 (see page 46).

Epidemics had appeared still earlier in some towns, and were stayed for the time by 'panic vaccination,' but directly afterwards vaccinations fell off. In Norwich, owing to an epidemic in 1812, parents were induced by *a present of half-a-crown* from philanthropic persons, to have their children vaccinated, and 1,300 were vaccinated in that year, but in the next two years only 47 and 11. In 1816 another epidemic brought up the vaccinations to 348, but in the next two years only 49 and 64 were vaccinated. Then came the severe epidemic of 1819, described by Dr. Cross ('A History of the Variolous Epidemic, which occurred in Norwich in the Year 1819.' London, 1820):—

Norwich Epidemic of 1819.

Population, 40,000. Small-pox deaths, **530**, of which 477 in *age-class under 6 years*.

Dr. Cross could only hear of 2 deaths in vaccinated persons.

to be dying out, at least as an epidemic disease. We see also that the epidemics are milder than of yore; they hardly ever reach the severity of a mild year (!) of the previous century.

Of 200 cases carefully observed in 112 families with 603 members, 2 were vaccinated some years previously, and their attacks were extremely light; 297 'survivors' and 89 vaccinated resisted infection; of the rest all but 15 were attacked.

Vaccinations fell off as Small-pox Epidemics declined.

The example of Norwich has been given.

In **Glasgow**, 1801-11, about 1,400 children were vaccinated yearly, but during 1812-18, the average was only 909; in the year 1818 itself only 650 were vaccinated.

In *Sweden*, 1818, vaccinations were only 57 per cent. of births; in 1822, only 70 per cent.; but in 1824, *when an epidemic began*, 93 per cent. ('Swedish Statist,' Central Bureau).

In *Denmark* the same thing is noticed. In 1821-2-3, births, 32,714, 34,755, 34,599; vaccinations, 21,193, 28,962, 29,429; but in 1824, *when small-pox increased*, births, 33,723, vaccinations, 38,334; and in 1825, births, 34,249, vaccinations, 39,279 (Report Select Committee).

Small-pox in the Vaccinated (Varioloid).

So mild were most of the attacks in the vaccinated, that a new disease appeared to have arisen, and it received a new name—'varioloid.' It was thus characterized by Dr. Luders in 1824:—(1) Eruption not in regular order; (2) vesicles imperfectly formed, and then dying away instead of going on to the pustular stage; hence (3) *absence of secondary fever*. Thus although the attack began like an ordinary attack in an unvaccinated person, yet in two or three days the

patient was convalescent, and many hardly kept their beds at all.

We must not take the word 'vaccinated' to mean successfully vaccinated always, and in our modern thorough manner. Lymph at first was scarce and costly. It was preserved on ivory points, or threads, or between two pieces of glass; non-professional vaccinators travelled through a country vaccinating the people without waiting to hear of the result, and such people were called 'vaccinated.' Sometimes lymph was taken long after the eighth day from the arm, Jenner's 'golden rule' being disregarded—to use only pure fluid lymph. Anybody and everybody vaccinated, each in his or her own way.

But still making all deductions, well vaccinated persons took small-pox and a certain proportion of them died. This proportion was very small compared with the fatality amongst the unvaccinated, it is true, but this is a question which will recur in a later chapter. For the present the observations of contemporaries, and their various theories, will be given.

Fatality of vaccinated and unvaccinated cases, early in the century:—

Norwich, 1819. 530 deaths, 2 in the vaccinated (Cross).

Philadelphia, 1823-4. 474 deaths, none in the vaccinated (!) (see Kübler).

Copenhagen, 1823-4. Of 659 vaccinated cases, 5 fatal; of 158 unvaccinated, 35 fatal (Möhl).

Digne, 1828. Of 478 vaccinated cases, 1 fatal; of 162 unvaccinated, 93 fatal (see Kübler).

Marseilles, 1828. Of 2,000 vaccinated cases, 20 fatal; of 4,000 unvaccinated, 1,180 fatal (Favart).

The Hospital, London, 1825. Of 147 vaccinated cases, 12 fatal; of 156 unvaccinated, 107 fatal.

The Hospital, London, 1829. Of 45 vaccinated cases, none fatal; of 100 unvaccinated, 54 fatal (see Wernher, 'Zur Impfrage').

Small-pox attacks Adults.

The change of incidence of the disease from an early age to a later age will now be shown by some examples, from the early decades of the century.

1822. London, Small-pox Hospital. 137 attacks in the vaccinated. Under 10 years, 5; 10-14 years, 10; 15-19 years, 48; 20 years and over, **74**.

1825. Milan (Hospital). 72 vaccinated cases. Years since vaccination:—2 years, 2; 7 years, 2; 11 years, 5; 12-18 years, **35**; 18-24 years, **29**.

New Lanark. 251 vaccinated cases (Gibson). Under 1 year, 10; 1-4 years, 69; 5-9 years, 74; 10-14 years, **69**; 15-19 years, **28**; over 19 years, 1. (Not one death!).

1823-4. Copenhagen (653 vaccinated cases). 4-5 years, 14; 6-10 years, 102; 11-15 years, 173; 16-20 years, **187**; 21-25 years, **156**; 25-30 years, 19; 30-32 years, 2.

So far, only vaccinated cases have been given. The era before vaccination will now be compared with the era of vaccination, as to age incidence.

Of 1,252 cases in three Prussian towns *before* vaccination began, 94·5 per cent. were under ten years; *not one was older than 20 years*.

Of 1,677 cases in Württemberg *after* vaccination

began, 18·4 per cent. were under 10 years, **42** *per cent.* were above 20 years old.

And if the deaths alone are considered, we may contrast Berlin with Marseilles. Of 6,705 deaths in Berlin in the eighteenth century (1758-74), 98·7 per cent. (nearly all) were under 10 years, 0·7 per cent. were above 15 years old. But after vaccination came in, of 1,473 deaths in Marseilles (1828), 85·8 per cent. were under 10 years, 9·3 per cent. were above 15 years old (observed by Robert).

Age-classes of 1,677 *cases* in the period 1831-36 in Württemberg kingdom (Heim):—under 10 years, 309; 11-20 years, 445; 21-30 years, **551**; above 30 years, **153**. Vaccination was obligatory (1818). Further, age-classes of 653 *vaccinated cases* in the third decade in Copenhagen, observed by Möhl:—0-3 years, none; 4-5 years, 14; 6-10 years, 102; 11-15 years, 173; 16-20 years, **187**; 21-25 years, **156**; 26-30 years, 19; 30-32 years, 2.

Contrast Lanark in the pre-vaccination era 1728-63; 622 *deaths*, all but 27 in the age class 0-6 years.

Deaths are contrasted with cases in the above, but enough is given to show the truth of the statement advanced, viz., that the age incidence was changed from childhood to an early adult age.

SMALL-POX IN THE ARMIES. REVACCINATION BEGINS.

Small-pox as an army disease was scarcely mentioned by the military surgeons of the eighteenth century, but towards 1820, and especially in 1820-30, it forced itself upon the notice of the authorities, and the revaccina-

tion of all recruits was early made compulsory in several armies.

Württemberg army, 1833.

Prussian army, 1834.

Hanoverian army, 1837.

Baden army, 1840.

Bavarian army, 1843.

The English army followed suit leisurely, 1858.

Taking the Prussian army as an example, Dr. Werner informs us ('Deutsche Med. Wochenschrift,' May 14, 1896) very fully on this subject as follows:—

'It has been remarked by authorities on army sanitation, as a striking fact, that in old works on army diseases, precise information on small-pox is wanting, and its greater extension in armies begins to be mentioned in the twenties. The explanation appears to be that owing to the very widespread character of small-pox in the earlier centuries, and the great susceptibility of mankind, it raged chiefly amongst children. It was decidedly a children's disease, and accordingly rarely appeared in the army, relatively speaking, and never extended much—like measles now-a-days. This was altered when with the introduction of vaccination, a portion of the children were protected against the disease. At first it was believed that the protection of one vaccination lasted for life, as with survived small-pox as a rule, and only slowly the experience was won that it is temporary, and requires renewal. The susceptibility of vaccinated children becomes marked in the second or third decade of life, and this was the cause why the armies, as vaccinations increased among children, gradually contained an increasing number of persons susceptible to small-pox. About the year 1819

small-pox began to extend in the Prussian army and to cause an increasing anxiety from year to year. Accurate statistics date from the year 1825.

Small-pox Deaths in the Prussian Army. 1825-34.

‘1825, **12**; 1826, **16**; 1827, **23**; 1828, **35**; 1829, **33**; 1830, **27**; 1831, **108**; 1832, **96**; 1833, **108**; 1834, **38**.

‘Yearly average per 10,000 strength, 3·6.

‘Yearly average per 10,000 Prussian population, 2·7.

‘In 1820, the vaccination of as yet *unvaccinated* recruits was offered at their choice, in 1826 it was made compulsory. But the deaths increased steadily, and in 1831 reached 7·5 per cent. It was now an established fact that also persons who had been vaccinated in infancy were attacked. In 1831 the Surgeon-General of the army recommended the vaccination of all recruits, whether they had been previously vaccinated or not, directly after joining. In the Third Army Corps this was expressly furthered under the particular direction of Prince William of Prussia, afterwards Emperor William I, who foresaw the importance of the measure for the safety of the army, and the results in this corps were so convincing that on June 16, 1834, a Cabinet Order made revaccination *compulsory for all recruits*.

‘The result is shown in the table that follows:—

(Actual) Small-pox Deaths in the Prussian Army after 1834.

‘1835-9. **5, 9, 3, 7, 2.**

‘1840-69. In thirty years, 51 deaths. Average under **2**.

‘Previous to 1834 the average small-pox rate was higher in the army than in the civil population. After this year it is steadily much lower, as shown in the seven successive quinquennia beginning 1835-9 and ending 1865-9.

‘Army: 0·49, 0·21, 0·06, 0·14, 0·04, 0·12, 0·11.

‘Population: 1·9, 2·1, 1·3, 2·6, 1·5, 3·0, 3·7.

‘But decade 1825-34, see p. 59:—

‘Army: 3·6. Population: 2·7.

‘This change is entirely due to the revaccination of all recruits, most strictly enforced since 1834. It is instructive to read about the measures adopted before 1834 to do away with small-pox, especially for those persons who appeal to improved sanitation and in particular to isolation. Isolation was most rigidly enforced; the patients were removed to small-pox stations and special houses—even seals were placed on the door of the patients’ room. The patients’ clothes were disinfected or burnt, and themselves and their attendants kept under watch and ward. All to no purpose—the pest found a way through the closed doors till suppressed by revaccination alone without the cooperation of any other sanitary measure.’

In the Württemberg army (revaccination compulsory in 1833), there was *not one death in the twenty years* 1851-70.

In the Bavarian army (revaccination began in 1843), there were *only 6 deaths during 28 years* 1843-70, while before 1843 there were 52 deaths during 9 years 1828-36 (‘Denkschrift’).

CHAPTER VII.

SECTION I.—EARLY THEORIES *re* SMALL-POX IN THE
VACCINATED.

JENNER and the early vaccinators firmly believed that one successful vaccination conferred a protection as lasting as that conferred by survived small-pox. Cases of small-pox in the vaccinated began to occur about 1804, and in 1805 a Commission of 25 members of the Royal Jennerian Institute examined the question. In 1806 (Jan. 2), their Report said that such cases undoubtedly had occurred, but were exceptional, and due to peculiarity of constitution, and that small-pox itself, whether inoculated or 'natural,' was sometimes followed by a second attack. Thus we have

Theory 1.—*A rare exception, due to peculiarity of constitution.*

But cases gradually accumulated and Jenner tried to explain them by a theory of imperfect vaccination, explained by the title of his pamphlet, 'Varieties and Modifications of the Vaccine Pustule, occasioned by an Herpetic State of the Skin.'

Theory 2.—*Imperfect vaccination, due to herpes.*

• Epidemics began to recur, and though they showed that most of the vaccinated were protected, yet though death was rare in the once successfully vaccinated,

attacks became more common. The mildness of the symptoms in most vaccinated cases gave rise to the theory that small-pox in the vaccinated was a new disease.

Theory 3.—*A new disease (variolois vaccinica).*

Freshly imported from China (Moreau de Jonnes); not imported (Jäger, Schönlein) but modified small-pox, modified by peculiarity of constitution, and resulting from combined small-pox and vaccination.

To Hufeland 'variolois vaccinica' was a new form of disease, a sort of modified variola, and he recommended *early revaccination* to remove a 'remnant' of susceptibility left behind by the first vaccination, in some individuals, not in all.

But the chief theory of all was that of 'degeneration of the lymph.'

Theory 4.—*Degeneration of vaccine lymph, viz., by repeated transference to human beings.*

The cry was, 'back to the cow,' and about 1830 the search was keen for cases of 'natural cow-pox' amongst cows, but such cases, when wanted, were rare.

In Württemberg kingdom, in 1825, a reward was offered for the discovery of cow-pox amongst cows.

Ritter, in 1830, found a fresh source in Kiel.

Estlin, in 1837, found a fresh source near Berkeley, in Gloucestershire, and raised a new stock.

Hering, in 1839 ('Ueber Kuhpocken an Kuhen,' Stuttgart, 1839), reported 69 outbreaks of cow-pox, and about 200 transferences to man. The local phenomena were in excess up to the third remove.

Bousquet, in 1836 ('Sur le Cow-pox, découvert a Passy, près Paris,'

1836), used lymph from the hand of a milker at Passy, near Paris, and raised a stock. Bousquet said that natural cow-pox was as rare in France, as it was common in Württemberg.

In Estlin's case about 20 or 30 transferences were made before the lymph began to act mildly; the National Vaccine Establishment rejected it.

Ceely, 1836, carefully described the later stages of natural cow-pox; he was never in time to see the vesicular stage; the deep ulcerations he ascribed to 'the merciless manipulations of the milkers.' (See 'Trans. Provincial Med. and Surg. Assoc.', vols. viii. and x.).

Later on Marson, Gregory's successor at the Small-pox Hospital produced a table of 5,982 cases during 16 years, 1836-1851. Of 3,094 vaccinated cases, 268 were fatal (9 per cent.); but of 2,654 unprotected cases, 996 were fatal (37 per cent.); and of 47 inoculated cases, 9 were fatal (17 per cent.). But arranged according to the number of vaccination marks found to exist: of those with 1 cicatrix, 9 per cent. died; with 2, 6 per cent.; with 3, 4 per cent.; with 4 or more, 1 per cent.

Theory 5.—*The cicatrix theory.*

Some said, 'The more the better,' and vaccinated in a dozen places on each arm. They forgot that the early vaccinists had conferred absolute protection by a few slight scratches or incisions, and tested their cases soon afterwards.

The German Vaccination Commission in 1884 concluded that 'at least *two* well-developed vesicles are required to confer protection against small-pox.'

Hodenpyl in Rotterdam (1818), and **Elsässer** in Stuttgart, 1820, early put forward the right theory, viz.

Theory 6.—*A gradual decline of vaccination protection.*

Hufeland also recommended revaccination, on different grounds, and so in England did **Gregory**; in Germany, Wolfers and Dornbluth; in Russia, Harder.

Gradual rise of vaccinated cases in the hospital. In 1809, admissions 146 (4); in 1819, 97 (17); in 1822, 194 (57); in 1825, 305 (147)! Gregory's faith in vaccination was shaken by this.

Gregory, in 1824, reported no death in 45 vaccinated cases; in 1825, 12 deaths in 147 vaccinated cases, and 107 deaths in 263 unvaccinated cases (8 per cent. and 40 per cent. respectively).

Light cases were not admitted to the hospital, as a rule.

Earlier still, Thomson (Edinburgh) had reported 1 death in 310 vaccinated cases, and 50 deaths in 305 not vaccinated cases.

This theory, which a hundred years of experience of the use of vaccination has taught the world, results simply and obviously from one fact, viz., the change of incidence to adult age. Could not this have enlightened our forefathers? No!—for they confused chicken-pox with modified small-pox (Thomson exposed this error), and chicken-pox (varicella) being a specifically distinct disease (never fatal), was of course unaffected by vaccination, while small-pox rarely attacks the recently vaccinated. Thus varicella and varioloid were confused together. Further, in the third and fourth decades, vaccination was not so diligently prosecuted as in the first two decades, and a great many of the young were left unvaccinated and therefore liable to small-pox, thus the age incidence contrast became less marked later on. Opponents have asserted that the high mortality amongst the young unvaccinated as compared with the adult vaccinated—for vaccination protects against death,

long after it has ceased to protect against *attack*, by small-pox—is due to their tender age and lower resistance in general. But the comparison of the vaccinated and unvaccinated at the same ages refutes that objection. Examples will be given later.

SECTION II.—TRANSFERENCE OF SMALL-POX FROM MAN TO THE COW. ‘NATURE OF COW-POX.’

In 1838, Ceely, a medical practitioner, observed in the village of Oakley, in the vale of Aylesbury, a *simultaneous* outbreak of cow-pox amongst several cows and calves who had frequented a spot where bedding from a small-pox patient had been exposed.

In 1839, Ceely inoculated a calf with small-pox lymph, some nodules appeared by the 9th day. Giving up the expectation of anything further from this experiment, he then vaccinated the same animal with ‘humanized lymph.’ By the next day to his surprise some of the above nodules became vesicles, and showed all the signs of cow-pox. Later on the vaccine vesicles also developed, and the whole began to dry up soon after a fortnight.

In another attempt Ceely succeeded in raising a few pustules after inoculation of another calf with small-pox lymph. The lymph from these two calves caused vaccine vesicles in human beings which could be carried on through several transferences (Ceely’s assistant, vaccinated accidentally from the first calf, had a general eruption over the body; no doubt small-pox). Thus Ceely succeeded in producing cow-pox and vaccine lymph by inoculating calves with small-pox materia (see p. 66).

In 1840, Badcock of Brighton also succeeded in inoculating the cow with small-pox and raising a supply of vaccine lymph.

In 1838, Thiele in Kasan reported similar results.

1839, Reiter in Munich succeeded in 'inoculating' two cows from a small-pox child. Two nodules (papules) and a vesicle developed on one of the animals, and a child vaccinated from the vesicle had a general eruption.

In other experiments of Reiter, only nodules developed, *but other cows in the same building had spontaneous cow-pox afterwards*; it did not appear successively.

In 1865, a Commission in Lyons—Chauveau, Viennois, and Meynet, failed to produce cow-pox and to raise a stock of 'vaccine' by inoculating the calf with small-pox. They only succeeded in causing papules; the contents caused *small-pox* in man.

But in contradiction to this the transference of small-pox to the calf (and the production of *cow-pox*—though difficult to effect, and under conditions not yet thoroughly determined—thereby) *has since been repeatedly and amply proved* by the experiments of Voigt in Hamburg (1881), Haccius in Genf (1890), King (1891), Fischer in Carlsruhe, Klein and Copeman in London, Simpson, Hime (1892), and Freyer in Stettin (1895). The strain of lymph procured by Voigt, the 'Hamburg lymph,' has proved to be of remarkable potency and steadiness, as proved when the time came round for infants vaccinated by it, to be revaccinated as school children. The transference once effected, the lymph is propagated through several calves successively, and the resulting lymph, though it has a severer local action than ordinary humanized lymph, never produces a general erup-

tion, or any symptoms resembling small-pox (Dr. Kübler). Small-pox is thus truly attenuated. Cow-pox is milder than small-pox, and for the very reason that it is an attenuated modification it does not confer so permanent a protection as survived small-pox. It requires to be renewed, as the epidemic of 1870-5 reminded Europe.

Eileerts de Hahn, also Voigt of Hamburg, showed that apes can be successfully inoculated with small-pox virus. Voigt in 1881, succeeded in 'inoculating' a calf with human small-pox lymph, and after 20 removes in calves used the lymph, 1882, as a 'vaccine' on children. In 1893, when the time came round for revaccination of the same children, the failures were more numerous than with children vaccinated in 1882 with ordinary lymph, showing greater potency of the 'Hamburg lymph.'

SECTION III.—THE NATURE OF COW-POX, AND THE SUPPLY OF VACCINE LYMPH.

No specific micro-organism has been discovered as yet in cow-pox lymph, or in lymph from small-pox vesicles, but modern science teaches us that cow-pox is an attenuated modification of small-pox itself, 'attenuated' by passing through the cow. Therefore, Jenner showed the insight of genius in inventing the term '*variola vaccinae*.' Experimenters have with extreme difficulty inoculated the cow (or calf or heifer) with small-pox material, and have used the resulting lymph after one or two removes, as a vaccine lymph. Natural genuine cow-pox in the cow is a rare occurrence (except in Württemberg, apparently), but various stocks of lymph have from time to time been started from such

occurrences. The search was especially keen in the third and fourth decades of the last century, when many people attributed the reappearance of small-pox epidemics, and the change of age incidence of the disease to 'degeneration of the lymph,' and obstinately ignored the true cause, the gradual renewal of susceptibility to small-pox after vaccination, as time goes on.

Dr. Copeman in a paper read before the Royal Medical and Chirurgical Society of London in Dec., 1901 (see 'Medical Press,' Dec. 18), has shown that a perfectly efficient and safe vaccine lymph may be procured without difficulty by first *inoculating a monkey with true small-pox virus*, and then a calf from the monkey. The monkey is nearer to man than the calf, and no difficulty is found by this procedure; further, the disease is attenuated by a different gradation, and is thus essentially modified. But the report of Dr. Copeman's paper continues thus, 'He thought the evidence went to show that though ordinary, even severe small-pox, was with difficulty inoculated in the calf, the inoculated variety of small-pox, *i.e.*, that which was produced when the inoculation of small-pox virus was the recognized means of obtaining immunity, might be transmitted to animals, and thus produce the disease in the calf from which vaccine was derived.' This takes no account of the monkey. The variolous disease must be profoundly modified by the system of the monkey, and it is again attenuated by the calf. We will here give an account of the modern treatment of vaccine lymph obtained from the calf, under strict antiseptic conditions, as described in Dr. Copeman's paper.

Cultures from recent calf lymph show colonies of various micro-organisms, and opacity in stored lymph in

capillary tubes is owing to an increase of these bacteria in the tubes. Dr. Copeman has shown that this growth is stopped by the addition of a mixture of pure glycerine, (50 per cent.) and water; culture plates of agar-agar showing fewer and fewer colonies as time goes on, till after the lapse of a month no organisms are found in the culture medium. This method will also destroy tubercle and erysipelas bacilli when added experimentally. In the German Vaccine Lymph Institutions glycerine has long been in use, but it is Dr. Copeman's discovery that it gradually destroys all foreign micro-organisms when stored for a certain time.

The lymph is taken from the calf, 120 hours after inoculation, by a sterilized Volkmann's spoon, mixed with six times its weight of a sterilized mixture of equal parts of pure glycerine and distilled water, 'centrifuged,' stored for a month in an ice chest—agar plates being taken weekly till no organisms are obtained—tested in use as to intensity of action, and finally stored in capillary tubes hermetically sealed and kept in ice.

SECTION IV.—THE HORSE-POX THEORY.

There were two beliefs firmly held by Jenner, the first was that the protection of vaccination was life-long, and the second was his horse-pox theory. The former was erroneous but justifiable at the time and shared by everyone, for vaccinated persons could not 'take' small-pox though tested in all sorts of ways; the latter remained a moot point for many years. His contemporaries, Woodville and Pearson and many other surgeons contested the horse-pox theory with warmth. They had failed to produce cow-pox in the cow from 'grease' in horses. Grease in horses is a morbid condition attended with a persistent watery discharge from the heels, which are severely

chapped; but this is only the chronic sequela of acute 'grease,' which gives rise to small vesicles, mostly overlooked amongst the hair. The acute stage 'is for the most part unnoticed,' Prof. Hering says.

But in 1801, a surgeon, Loy, published his 'Account of Experiments in the Origin of the Cow-pox,' Whitby, 1801. He had 'vaccinated' a cow on the udder with material from sores on the hands of a groom attending on horses with 'grease,' and a vesicle developed by the ninth day from which he vaccinated a child, and produced a regular vaccine pustule. A second child had been vaccinated direct from the stableman with similar result. He had also vaccinated a cow direct from a horse affected with 'grease,' and then a child from the cow. This child had sharp feverish symptoms and inflammatory signs, and 5 other children thence vaccinated showed much reaction. All these cases stood the test of subsequent inoculation; there was no general eruption in any of the cases.

In 1803, Sacco wrote from north Italy that he had successfully used material from the hands of a groom who had 'taken' horse-pox; also Lafont in Saloniki supported Jenner by similar observations (reported by de Carro).

In 1813, Jenner received horse-pox lymph, which he called 'equine,' from a 'veterinary surgeon' named Melon, and used it with success.

In 1817, Jenner reported a series of transferences during 8 months to several persons starting from the horse in this order; horse, man (Allen), two or three cows, man (Cole), man (Powell), man (Rudder), man (Martin), woman; and added that these persons all proved to be protected.

In more recent times the occurrence of vesicular eruptions in the horse which can produce symptoms like those of cow-pox in the human subject, have been confirmed by Lafosse of Rieumes (1860). Amiot and Bouley of Alfort (1880) and Peuch, near Toulouse in 1880 and in Algiers in 1882. The eruptions were not limited to the heels of the horse, but appeared also about the eyes, nose, and mouth, and were not easy to distinguish from other eruptions of quite different behaviour. Moreover 'equine' has been recognised by veterinary authorities such as Bollinger, Friedberger, and Fröhner, as an actually observed affection of horses. But it is at least certain that this particular disease is very rare, and has nothing to do with the ordinary 'grease' of the horse. It is really an attenuated small-pox, and

experiments in inoculating cows with small-pox confirm this view. But genuine horse-pox has almost ceased to appear since small-pox has become rarer. Thus Jenner had some grounds for his hypothesis after all, though the subject has long ago lost interest as regards vaccination.

CHAPTER VIII.

THE MIDDLE THIRD OF THE LAST CENTURY.

THE next great event in the history of vaccination and its effect on small-pox mortality is the great epidemic of 1870-5. The statistics for Sweden will first be brought up a stage further, and the figures for England will be commenced and brought up to 1853, when compulsory vaccination began. After this, three countries with compulsory vaccination will be compared with three countries without the same, up to the year 1869—the law in Prussia being first explained—in a remarkable table given in the ‘*Beiträge zur Beurtheilung.....*’ of the k. k. Gesundheitsamt, Berlin.

SWEDEN. (Small-pox mortality).

YEAR.	DEATHS.		VACCINA- TIONS.	YEAR.	DEATHS.		VACCINA- TIONS.
	Actual.	Per million.			Actual.	Per million.	
1822	11	4	72	1833	1,145	387	82
1823	39	15	71	1834	1,049	352	62
1824	618	226	88	1835	445	147	70
1825	1,243	449	74	1836	138	45	79
1826	625	223	63	1837	361	117	73
1827	600	212	66	1838	1,805	583	77
1828	257	90	64	1839	1,934	621	71
1829	53	19	65	1840	650	207	76
1830	104	36	68	1841	237	75	68
1831	612	211	72	1842	58	18	74
1832	622	213	75	1843	9	3	73

ENGLAND. (Small-pox deaths).

Year.	Deaths.	Per million living.	Year.	Deaths.	Per million living.	Chicken-pox (actual Nos.).
1838	16,268	1,064	1870	2,620	113	
1839	9,131	589	1871	23,126	1,012	
1840	10,434	661	1872	19,094	821	
1841	6,368	400	1873	2,364	98	
1842	2,715	168	1874	2,162	88	
1843	?	?	1875	952	35	
1844	?	?	1876	2,408	99	
1845	?	?	1877	4,278	173	
1846	?	?	1878	1,856	74	
1847	4,227	246	1879	536	21	
1848	6,903	397	1880	648	25	103
1849	4,644	264	1881	3,098	119	133
1850	4,665	262	1882	1,317	50	122
1851	6,997	389	1883	957	36	99
1852	7,320	401	1884	2,234	82	129
1853	3,151	171	1885	2,827	103	109
1854	2,808	151	1886	275	11	93
1855	2,525	131	1887	506	19	87
1856	2,277	116	1888	1,026	39	116
1857	3,936	202	1889	23	1	83
1858	6,460	329	1890	16	0	95
1859	3,848	193	1891	49	2	91
1860	2,713	136	1892	432	15	123
1861	1,290	64	1893	1,456	49	127
1862	1,579	78	1894	820	27	108
1863	5,891	286	1895	223	7	86
1864	7,624	364	1896	541	18	151
1865	6,361	301	1897	25	1	103
1866	2,977	139	1898	253	8	116
1867	2,467	114	1899	174	5	124
1868	1,994	91	1900	84	3	
1869	1,482	67				

The Law:—1840, vaccination provided gratis in every union; 1853, vaccination obligatory in infancy; 1867, vaccination compulsory under penalties; 1871, inspectors appointed; 1898, ‘conscientious objection’ is a valid excuse.

LONDON. (Small-pox deaths).

Year.	Deaths.	Per million of population.	Year.	Deaths.	Per million of population.
1838	3,817	2,169	1870	973	302
1839	634	353	1871	7,912	2,422
1840	1,235	673	1872	1,786	537
1841	1,053	563	1873	113	34
1842	360	188	1874	57	17
1843	438	225	1875	46	13
1844	1,804	890	1876	736	207
1845	909	440	1877	2,551	710
1846	257	122	1878	1,417	388
1847	955	427	1879	450	121
1848	1,620	724	1880	471	125
1849	521	229	1881	2,367	619
1850	499	215	1882	430	111
1851	1,062	448	1883	136	35
1852	1,159	478	1884	1,236	313
1853	211	86	1885	1,419	357
1854	694	277	1886	24	6
1855	1,039	408	1887	9	2
1856	531	204	1888	9	2
1857	156	59	1889	—	—
1858	242	90	1890	4	1
1859	1,158	425	1891	8	2
1860	898	323	1892	41	10
1861	217	77	1893	206	48
1862	366	128	1894	88	20
1863	1,996	687	1895	55	13
1864	547	185	1896	9	2
1865	640	214	1897	16	4
1866	1,391	457	1898	1	0
1867	1,346	436	1899	3	1
1868	597	190	1900	4	1
1869	275	87			

The Law as to Vaccination in Prussia previous to 1874.

Opponents of vaccination show such obstinacy on this question that a few lines must be devoted to it. The following has been extracted from the 'Denkschrift of the Imperial Gesundheitsamt,' Berlin, 1896.

'The assertion even still made ("Der Impfgegner," Oct., 1895—The Opponent of Vaccination) that in Prussia compulsory vaccination existed before the Vaccination Law for the Empire (1874), rests upon error.' The following is a proof of this:—

1801, July 11.—*Royal Order* to Medical and Sanitary College to collect evidence and report *re* Vaccination.

1803, Oct. 31.—‘*Regulation*’ to local authorities to encourage Vaccination short of compulsion.

1804, Oct. 13.—*Extension of preceding*, clergy to encourage Vaccination from the pulpit.

1809, Feb. 4.—*Ministerial Order*, surgeons to vaccinate *gratis* on certain days.

1810, Aug. 13.—*Ministerial Rescript*. If *compulsory vaccinations* are made on the occasion of a small-pox epidemic outbreak, they are to be *gratis*.

1825, May 1.—*Ministerial Rescript*. Vaccination to be made *general*, not legally, but administratively (auf administrative Wege). Local governments to take the necessary steps. As ‘worthy of imitation’ the Notification of the **Dusseldorf** Government of 1824, Nov. 13, is mentioned (*making vaccination compulsory under fine and even imprisonment*).

(Practically this Rescript made Vaccination compulsory. But all compulsion was done away with in the next Circular-Despatch from the Head Government, 1829).

1829, Jan. 29.—Circular order from the Royal Ministry in Berlin to all the Royal local governments. ‘The King’s Majesty has fresh occasion repeatedly to deny direct compulsory Vaccination and in particular is pleased to command the withdrawal (*Wiederaufhebung*) of the Order of the **Dusseldorf** Government, Nov. 12, 1824, in so far as it involves a direct compulsion to Vaccination.’

Compulsory vaccinations on the occasion of local epidemic outbreaks appear to be still feasible, but that they were rare, and of uncertain legality, the following shows:—

1834.—*Ministerial Rescript* to the Royal Gumbinnen Government. ‘. . . Whether Compulsory Vaccinations can be made in times and places where small-pox is epidemic is in fact doubtful (ist in der That noch zweifelhaft) . . .’

At last we come to the Sanitary Directions (Regulations) of 1835, August 8, 1835, ‘*Sanitäts polizeilichen Vorschriften (Regulativ) bei ansteckenden Krankheiten.*’ The sections relating to Vaccination (§§44 to 58) have been published (literally translated) by the writer, in the Practitioner, May, 1896, with ministerial circulars referring to it.

The following are the comments of the Imperial Health Office on this law (1896 Denkschrift).

‘By these Regulations there was no *direct* legal compulsion for anyone to be vaccinated, or to have his children vaccinated. Vaccination is “*urgently recommended*,” and “all intelligent persons are expected to further it by example and precept.” All officials to whom it may concern are to further Vaccination “on every occasion that offers.” Compulsory measures are to be adopted when epidemic outbreaks occur, *if necessary* (erforderlichen Falls)—(this provision is still in force in Prussia; it was not abrogated in 1874). No punishment was provided for the neglect of vaccination where small-pox was not present, but *parents, &c., were liable to be fined if the children under their care had small-pox, while unvaccinated without sufficient reason*. An *indirect* compulsion existed in so far that reception into public State-institutions, and the enjoyment of certain benefices, also reception into boarding establishments connected with public Educational Institutions (welche mit öffentlichen Unterrichts-Instituten verbunden sind), are made dependent on evidence of vaccination or revaccination. (§§ 54 and 56).

‘*But this last did not apply to schools in general*, for it is expressly mentioned in § 54 that “Schoolmasters” would do well (wohl thun würden), to make certain about the vaccination of pupils entering.

‘It was not till 1871, that reception into public schools not under obligatory Inspection was made dependent on proof of vaccination.

‘As to *revaccination*, it was merely *recommended* for those who had been (successfully) vaccinated long previously, “on account of the greater security thereby effected.”

‘That this law did not make vaccination compulsory is proved by a ministerial order of May 28, 1841, which contains these words, “because there exists no legal compulsion to vaccination” (“.....**weil kein gesetzlicher Zwang zur Impfung bestehe.**”)

‘In 1863, parents were ordered to take their recently vaccinated children for inspection under penalties, (fine of 15 Sgr up to 1 Thaler, or else an imprisonment).’

It is plain from all the foregoing extracts that in the nine old provinces of Prussia no general compulsory law as to vaccination existed; in times and places free from small-pox the authorities had no means of forcing negligent or disinclined parents to have their children vaccinated. *Indirect* compulsion existed only to this

extent, that parents were liable to be punished if their children had small-pox while unvaccinated.

The 'Sanitary Directions' (Regulations) of 1835 are prefaced by a formal Cabinet order by the King, in the form of an open letter to his Ministry, making the Regulations the law of the land; and ordering the Ministers to publish them. The following is the letter in full:—

'With regard to My letter of the Jan. 19, 1832, in which I brought to the knowledge of the State Ministry My appointment of an Expert Commission under the Presidency of General-Lieutenant von Thiele, to frame a general "Regulativ" on the procedures to be adopted in infectious diseases, I forward with a Report of Gen.-Lieut. von Thiele of June 17 of this year, the Sanitary Directions drawn up by the Commission, together with Directions for disinfective procedures and popular Information on the nature and treatment of Infectious Diseases.

'I have approved and confirmed the Regulations with the Command that they are to be carried out by everyone in every part of My realm in avoidance of the fines and imprisonments threatened, and that they be put in practice by all Authorities concerned.

'Earlier Directions, so far as they differ from these.... are revoked. The State Ministry will publish the Regulations with the two Appendices, and this letter.'

FRIEDRICH WILHELM.

Berlin August 8, 1835.

To the State Ministry.

This merely formal letter is inserted here because someone wrote to the 'Times' (Nov. 13, 1901) to the effect that there seemed to be 'ambiguity' as to whether the Regulations themselves *made vaccination compulsory or not*, but that a Royal proclamation (!) accompanied them, and there was no ambiguity if the '*Proclamation (!) and the Regulations were taken together*'; hence that Prussia enjoyed compulsory vaccination ever since 1835 (!), and in fact was 'the best vaccinated country in Europe' (!) in 1871.

Lastly, the 'Regulativ' of 1835 made 'Inoculation illegal.

In the next Table three countries in which vaccination was compulsory are contrasted with three countries in which there was no general compulsory vaccination.

SMALL-POX DEATHS PER MILLION INHABITANTS.

<i>Countries with Compulsory Vaccination.</i>			<i>Countries without Compulsory Vaccination.</i>		
Bavaria.	England.	Sweden.	Prussia.	Austria.	Belgium.
1844-5 55		1844 2	1844 270		
1845-6 32		2	159		
28		1	153		
50		4	95	1847 160	
131		21	137	215	
238		99	108	293	
1850-1 106		1850 395	1850 157	1850 161	
132		707	130	111	1851 156
103		433	189	116	1852
129	1853 171	78	395	238	1853 } 114
66	151	57	436	284	1854 }
107	131	11	97	476	1855 97
34	116	14	73	164	1856
69	202	152	133	123	1857
32	329	345	264	218	1858 } 241
28	193	388	196	262	1859 }
1860-1 16	1860 136	1860 184	1860 190	1860 269	1860
26	64	49	302	243	1861
23	78	37	211	333	1862
23	286	76	338	352	1863 } No returns.
46	364	182	463	364	1864 500
120	301	323	438	228	1865 1,165
250	139	292	620	359	1866 212
190	114	252	432	469	1867 111
101	91	342	188	355	1868 170
1869-70 75	1869 67	1869 354	1869 194	1869 352	1869 329
Av. of 26 yrs. } 85.	Av. of 17 yrs. } 167.	Av. of 26 yrs. } 189.	Av. of 26 yrs. } 248.	Av. of 23 yrs. } 272.	Av. of 16 yrs. } 273.

The very remarkable agreement between the average rates of the three countries *without* compulsory vaccination strikes the reader at once, and the rates of the three countries with compulsory vaccination would have agreed more closely, if, vaccination had been better practised.

It can be shown that vaccination was backward in England also. During 1848-52 (births 568,811, public vaccinations 180,960 of infants under 1 year, and 185,139 of older children), public vaccinations were two-thirds of the births. Also much of the mortality occurred in the age class under 1 year. Year 1845, London deaths 909, of which 209, (nearly one-fourth), were deaths of infants under 1 year old.

ENGLAND. (Vaccination after 1853 Law).

Year.	Births.	Vaccinations under 1 year.	Vaccination of older children.	
1854	623,699	408,829	290,111	
1855	623,181	354,979	109,120	} A falling off already.
1856	640,840	350,847	84,165	

But how many of these vaccinations were successful we do not know. We know that during the period September, 1853, to April, 1857, **4,044** children were vaccinated at the Central Vaccination Station in London, but only **852** of them were brought for inspection, and only **142** received certificates of successful vaccination.

Sweden also was remiss. The vaccinations during the period 1861-69 were only 50 per cent. of the births on an average in Stockholm, and 74 per cent. in all Sweden ('Beiträge zur Beurtheilung'). (See Table on page 72).

CHAPTER IX.

THE GREAT EPIDEMIC, 1870-5.

The pandemic of small-pox in Europe, 1870-5, taught Europe some lessons. It visited each country for about two years, as usual with epidemics, and was the second great epidemic of the century; the other was in 1838. As far as Europe is concerned, the epidemic began in France, and it sharply divided those countries with compulsory vaccination from those countries without compulsory vaccination, by the mortality rates. By 'rate' is meant here deaths per million living. But the mortality in London, great as it was, is found on examination to be not quite equal to that of the yearly average in the eighteenth century. We know of 18,477 deaths, and there may have been more, by small-pox in London in the decade 1791-1800—the number was greater in the middle of the eighteenth century. Thus the yearly average was 1,848 deaths in a population of say 740,000 (742,000 in census of 1801), giving at least an average rate = **2,497** *for each year* during the decade 1791-1800. In 1871, in London, the rate was **2,432** (7,912 deaths in a population of 3,254,260).

Again, of the 10,671 small-pox deaths in London during the 3 years 1870-2, no less than 3,842, *i.e.*, *above a third, were deaths of children under 5 years*, therefore presumably never successfully vaccinated, from what is known of vaccination and small-pox after a century's

experience. *Vaccination really obligatory in England was only just beginning, seventy years after the introduction of vaccination, when this epidemic visited us.* But still there was nominal obligation (since 1853), and in this respect England, Sweden, and Bavaria were better off in the epidemic period than Prussia, Austria, and Belgium, with no general obligatory vaccination.

The vaccinations per cent. of the births in Berlin for the half dozen years before the epidemic are as follows:—

1865-70.—36, 38, 53, 57, 58, 29; and Guttstadt declares that these low percentages are higher than the actual truth. Opponents of vaccination may harp on the 1835 law and the Royal proclamation taken together, but there are the actual vaccination percentages; for every 100 children born living in the year 1864, only 36 vaccinations were made in the year 1865, and so on.

The First Lesson of the Great Epidemic, 1870-5.

Comparison of countries with and without compulsory vaccination, during the period 1870-5.

Small-pox deaths per million of population.

With compulsory vaccination.

Year.	England.	Scotland.	Bavaria.	Sweden.
1870	113	34	185	183
1871	1,012	428	1,045	78
1872	821	718	611	81
1873	98	327	176	261
1874	88	358	47	936
1875	35	21	17	461
Average (6 years)	361	314	346	333

Without compulsory vaccination.

Year.	Prussia.	Austria.	Belgium.	Netherlands.
1870	175	302	818	196
1871	2,432	392	4,168	4,355
1872	2,624	1,899	1,560	1,021
1873	356	3,147	333	95
1874	95	1,743	369	34
1875	36	576	313	50
Average (6 years)	953	1,360	1,293	958

There is in the above Table a very remarkable agreement between the four countries with compulsory vaccination; they have nearly the same average rate, while the rate of any one of the other four countries is three or four times as great. The epidemic acted like a touchstone. (In 1872, a law was passed in the Netherlands making admission to a school dependent on production of a certificate of vaccination).

In Berlin the rate for the year 1871 was 6,326 per million! It has already been demonstrated that Prussia was without general compulsory vaccination.

Second Lesson of the Great Epidemic. Age-classes in various countries.

Deaths in each age-class per 1,000 of the deaths at all ages (*Dr. Kübler*).

Vaccination not compulsory.

Age-Class.	Netherlands.	Berlin.	Leipsig.
	1870-3.	Jan. 1, 1871 to July 31, '72.	1870-1.
0-1	162	204	304
1-5	323	234	422
5-10	110	48	45
10-20	92	34	18
20-30	95	118	26
30-60	198	319	164
Above 60	20	43	21

Vaccination compulsory.

Age-Class.	Hesse. 1870-2.	Scotland. 1865-74.	Bavaria. 1871.	Age-Class.
0- 1	154	171	138	0- 1
1- 5	30	94	57	1-10
5-10	10	95	439	20-50
10-20	24	190	366	Above 50
20-30	124	223		
30-60	529	210		
Above 60	128	18		

Here we see a remarkable difference between the first three and the second three. The Netherlands, Berlin, and Leipsig had no general compulsory vaccination law; the other three countries had. Excluding infants under one year, we find that the chief mortality in the three former fell upon the young, while in the three latter it affected the age-classes above 20 years.

The Third Lesson of the Great Epidemic. Once-vaccinated Bavaria.

The most impressive lesson of all was in the fact that in a severe epidemic once-vaccination in infancy did not prevent numerous attacks and numerous deaths amongst the vaccinated in a well vaccinated country—as far as vaccination in infancy is concerned—like Bavaria, where practically the whole population was once-vaccinated.

In Bavaria, of 30,742 small-pox attacks, 29,429 were in the vaccinated. After all, the attacked formed only 0.68 per cent. of the population, i.e., 1 person in every 150 of the population in round numbers was attacked. And the death-rate, as we have seen, was far lower than in

countries without compulsory vaccination in infancy. '*It only showed*' (said Dr. Koch before the German Commission of 1884, of which he was a member) '*that the vaccination which we formerly had was insufficient, and that it must be made complete by revaccination.*' And Dr. von Kerchensteiner:—'**that is the very reason why we introduced compulsory revaccination.**'

The Netherlands immediately adopted a law making the entrance to school depend on vaccination. The children attend school at an early age, but on the other hand attendance is not compulsory; also there is only once-vaccination.

England had just framed a law, after the Report of the Select Committee of the House of Commons, 1867, and had amended it in 1871, when the epidemic burst upon us, and cost over 40,000 lives in two years. So England trusted to the new law afterwards instead of adopting revaccination. *England is now in the same position as Bavaria before 1874.*

The Fourth lesson of the Great Epidemic.

I. The German army:—

The fourth lesson was, like Bavaria's experience, a most convincing proof of the necessity and value of revaccination. A small section of the German population enjoyed the protection of revaccination, and was but slightly affected by the epidemic, though exposed to infection far more than the rest of the population. That section was the German army in the Franco-Prussian war.

From Guttstadt's figures, (cited by Vogt) we learn

that while during 19 months 52 per ten thousand of the civil population of Berlin died of small-pox, the Prussian army lost in 12 months only 2·5 per ten thousand of strength, and the whole German army only 3·5. If we reduce the civilian deaths by $\frac{7}{19}$ to make the periods equal, then the civilian loss was ten times the army loss. If we take the age-class, 20 to 30 years, to correspond with the chief part of the army, then the civilian loss in this class, reckoned to 12 months, was nearly 6 times the army loss.

II. Comparison of mortalities of French and German armies:—

The whole German field army of over a million soldiers, though much exposed to infection, lost only 297 by small-pox, while as to the French army, one garrison town in France (Langres) lost more than this, (334). Thiers described small-pox in Belfort as 'more dreadful than the war itself,' and Colin reported 1074 deaths of soldiers in one hospital alone, Bicêtre in Paris. So we may imagine what the French army lost altogether, even if we do not accept the subsequent unofficial estimate adopted by a French Minister of War, viz., 23,400. (This estimate is founded on a paper read at the St. Petersburg Statistical Congress of 1872).

We know that the Prussian army was well vaccinated up to the war, when the supply of lymph fell rather short. We have now to show that the French army was badly vaccinated. From the year 1832 till 1859, small-pox caused 39 per cent. of all deaths. On Dec. 31, 1857, vaccination of all recruits was ordered without regard to the presence or absence of previous marks, and the small-pox deaths during 1862-72 fell to 19 per cent. (excluding the year of war). But still, vaccination was

remissly carried out. From official reports we learn that in 1866, of 45,064 recruits only 33,513 were vaccinated; in 1868, of 82,203, only 47,324 were vaccinated, and in 1869, of 115,876 recruits, only 54,720 were vaccinated; less than half! But worse, of the first vaccinations *only 37 to 49 per cent. were successful*, and of the second vaccinations—for the recruits were vaccinated twice if necessary—**only 34 per cent. were successful!**

Further the deaths amongst French prisoners on German soil were 1,963, while the immobile German army lost 162.

Total deaths in German army, mobile and immobile, **459**—(of which only **238** belonged to the Prussian army, mobile and immobile).

Germany took these lessons to heart, and the consequence was **the German Vaccination Law of April 8, 1874**, by which:—

(1) *Every child within the second year of life*, also

(2) *Every school child, within the twelfth year*, (unless an attack of small-pox, or successful vaccination, has occurred within the 5 years previous), must be vaccinated.

This law for the German Empire has not abrogated the old Prussian law of 1835, by which compulsory vaccination can be made in any house or locality where an epidemic outbreak occurs.

Germany has had a quarter of a century of experience of the revaccination of all school children, and the result is that *small-pox epidemics have long been unknown in Germany*.

In the year 1899, there occurred 28 deaths by small-pox in the German Empire (pop. 54,000,000), giving a rate per million = 0.5.

THE RESULTS OF THE GERMAN VACCINATION LAW, 1874.

(Small-pox deaths per million living).

(1) Before the Law of 1874.

Year.	Prussia.	Bavaria.	Württemberg.	German Empire.*	Contrast Austria.
1866	620	120	133		368
1867	432	250	63		484
1868	188	190	19		370
1869	194	101	74		374
1870	175	75	293		293
1871	2,432	1,045	1,130		383
1872	2,624	611	637		1,866
1873	356	176	30		3,094
1874	95	47	3		1,725

(2) Since 1874.

1875	36	17	3		576
1876	31	13	1		406
1877	3'4	17	2		555
1878	7'1	13	0		631
1879	12'6	5	0		534
1880	26	12	5'6		674
1881	36'2	15	3'6		807
1882	36'4	12	6'6		947
1883	19'6	6	35'2		596
1884	14'4	1	11'6		530
1885	14	3	0		600
1886	4'9	1	1	4'2 (1886)	400
1887	5	1'8	0	3'5	417
1888	2'9	3'8	0'5	2'3	615
1889	5'4	5'2	0	4'1	537
1890	1'2	1'5	0	1'2	249
1891	1'2	1'2	0	1'0	287
1892	3'0	0'5	0	2'1	256
1893	4'4	0'7	1	3'1	244
1894	2'5	0'3	0	1'7	105
1895	0'8	0'2	0	0'5	49
1896	0'2	0'2	0	0'2	36
1897	0'2	0	0	0'1	61
1898	0'4	0'3	0	0'3	
1899				0'5 (1899)	

Thus the mortality is not merely low now and then for a year or two, but *keeps steadily low*, owing to the absence of epidemic outbreaks.

No other country can show a death-rate so persistently low.

* Statistics begin in year 1886.

These 28 deaths occurred in 21 different districts, (and the highest number in any one district was 3); this shows that epidemics cannot get a start in Germany; the whole population is well protected. Most of the cases occur near the frontiers of badly vaccinated countries, (Russia, Austria, &c.). In 1899, no case occurred in any large town. Thus, the result of the law is a brilliant success, patent to the world.

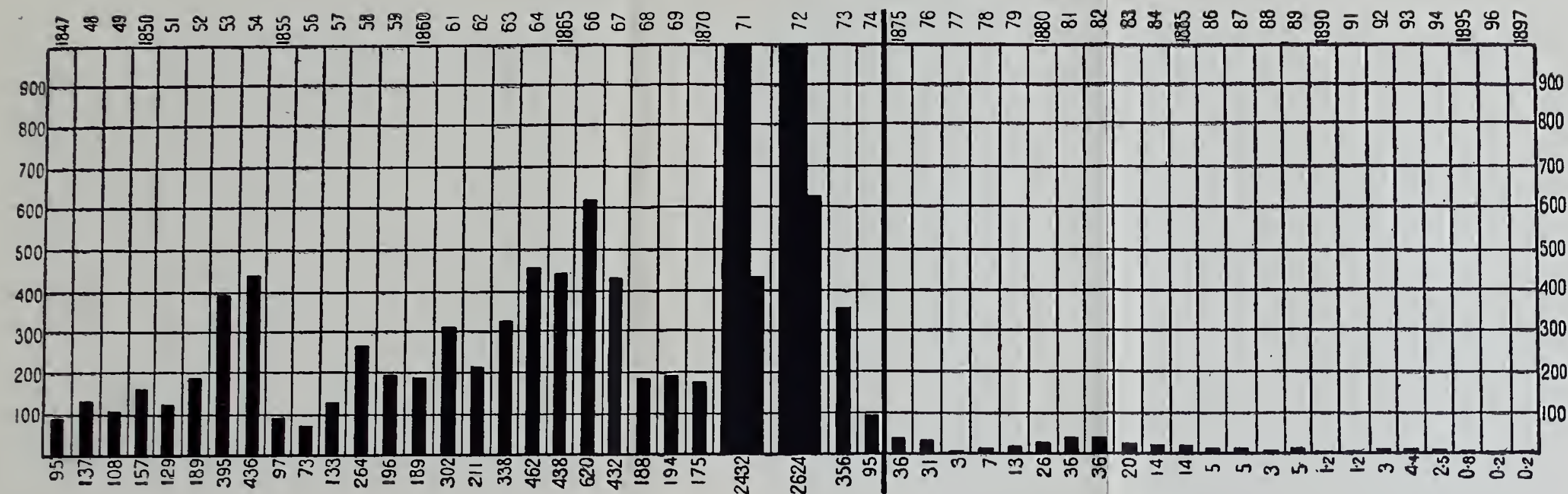
The text which accompanied the official statistics laid before the German Vaccination Commission of 1884 contains the following remarks on Prussia and the 1874 law:—

‘From 1875 onwards the influence of this law becomes apparent, for.....the small-pox mortality..... now fell to, and has persistently remained at a lower figure than any since the beginning of the century. That this striking diminution was really the consequence of compulsory vaccination, and not merely an effect of the great epidemic is proved by the following table (viz., for Austria).

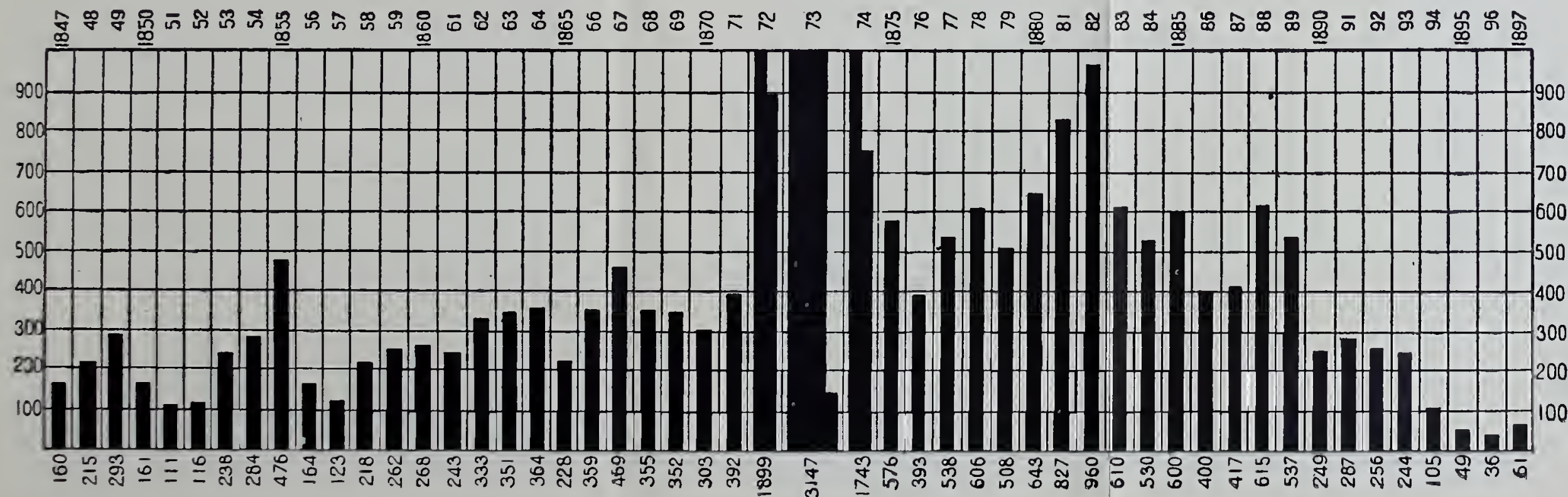
‘Previously to 1871, small-pox mortality in Austria behaved much like that of Prussia, though higher on the whole. The great epidemic of 1872-4 was more fatal and lasted longer than in Prussia. During the next two years the mortality fell, as usual after epidemics. Here the influence of the epidemic in lowering the mortality ceases, and the latter rises at once to its old figures, viz., as before the epidemic, and even higher, and this rise was not merely temporary.

‘The remarkable and persistent decline in Prussia since 1875 can only be due to the vaccination law of 1874, because all other conditions remain the same in the two countries. The only difference is that in

PRUSSIA, 1847-1897.
SMALL-POX DEATHS PER MILLION OF POPULATION.



AUSTRIA, 1847-1897.
SMALL-POX DEATHS PER MILLION OF POPULATION.



Prussia the re-vaccination of all (school) children at the age of 12 years was made compulsory in 1874.'

After some years, in response to anti-vaccination petitions, **the German Vaccination Commission of 1884** was appointed, consisting of **18** experts in the subject (*Sachverständigen*) all of them medical men. Conclusions of the Commission (which sat daily for one week only):—

'1. With rare exceptions, one survived attack of small-pox confers immunity against subsequent attacks.

'2. Vaccination is able to confer a protection of a similar character.

'3. The duration of the protection afforded by Vaccination varies within wide limits, but is on the average ten years.

'4. At least two well-developed vaccine vesicles are necessary to ensure an efficient protection.

'5. Revaccination is necessary ten years after primary vaccination.

'6. The vaccinated condition of the Community increases the relative protection against small-pox acquired by the Individual by vaccination, and hence Vaccination is beneficial not only to the individual, but generally.

'7. Vaccination may have an injurious effect, in certain cases. In the use of human lymph the danger of transferring *syphilis*, although extremely slight, cannot be entirely excluded. Any other bad effects are apparently due to accidental wound diseases.

'All these dangers may, by precautions in the performance of vaccination, be reduced to such a minimum as to make the benefit of Vaccination infinitely outweigh any possible injurious effects.

'8. Since the introduction of Vaccination, no scientific-

ally proveable increase has occurred of any particular disease, or of the general mortality, such as might be looked upon as a consequence of vaccination.'

Conclusion No. 6 is of extreme importance, and results in a great measure from the behaviour of the small-pox mortality of the Prussian army before and after the Law of 1874. The army was well revaccinated ever since 1834, several decades previously.

The Law of 1874 made no difference in the Army vaccination, but it made a difference at once in the Army mortality. Previous to the law there were more cases each year in the army than after the law. There were 51 deaths during the whole period 1840-69. But after the year 1874 *there was not a single death till the year 1884*—a reservist, twice unsuccessfully vaccinated in the Army—and there has been one death since, viz., in 1898—two deaths in a quarter of a century. This is because after 1874 the army found itself surrounded by a well-protected community, which fact very much increases the protection individually acquired by vaccination. This proves again that it is 'the right and duty of the State,' as Koch said, 'to ensure a well-protected condition of the whole community,' *i.e.*, to insist on each individual being well-protected, and this means revaccination.

The success achieved by vaccination properly adopted, as the experience of so many years of vaccination teaches, is not attained without a very perfect machinery in Germany. Vaccination is a serious business with them, and they provide for it thoroughly. There are no less than twenty-five State Institutions for Vaccine Calf-Lymph in Germany, all under the strictest State

TEN YEARS' VACCINATION IN GERMANY (1888-97).

INFANTS.

Year.	1. Born in previous year.	2. Vaccination due after deductions.	3. Vaccinated.	Per cent. of 1.	Per cent. of 2.	4. Successfully vaccinated.	Per cent. of 3.	5. Certified unvaccinated.
1888	1,757,079	1,458,062	1,305,626	74	90	1,265,758	96	152,291
1889	1,761,407	1,458,347	1,299,984	74	89	1,258,348	97	158,366
1890	1,772,570	1,473,464	1,300,136	73	88	1,266,349	97	173,328
1891	1,759,253	1,481,102	1,308,044	74	88	1,277,319	97	173,058
1892	1,840,172	1,529,558	1,340,659	73	88	1,304,467	97	188,899
1893	1,795,971	1,518,793	1,326,754	74	87	1,278,383	97	192,038
1894	1,865,715	1,592,994	1,391,019	75	87	1,366,449	98	201,975
1895	1,841,205	1,596,526	1,403,192	76	88	1,378,446	98	193,334
1896	1,877,278	1,587,124	1,394,396	74	88	1,359,864	97	192,721
1897	1,914,749	1,657,662	1,455,349	76	88	1,409,312	97	202,313

SCHOOL CHILDREN.

Year.	1. Vaccination due after deductions.	2. Vaccinated.	Per cent. of 1.	3. Successfully vaccinated.	Per cent. of 2.	4. Remaining on the lists for vaccination.
1888	1,220,594	1,181,858	97	1,063,940	90	38,706
1889	1,224,507	1,185,505	97	1,068,552	90	38,967
1890	1,202,115	1,163,132	97	1,062,645	91	38,906
1891	1,192,059	1,154,559	97	1,068,662	92	37,439
1892	1,139,805	1,104,162	97	1,018,152	92	35,610
1893	1,143,947	1,107,025	97	1,015,220	92	36,914
1894	1,179,075	1,143,021	97	1,074,797	94	36,054
1895	1,142,153	1,110,708	97	1,043,281	94	31,445
1896	1,169,473	1,138,831	97	1,056,340	93	30,741
1897	1,205,449	1,174,827	97	1,076,045	90	30,622

Thus 97 per cent. of the first vaccinations, and 90 per cent. of the revaccinations, are successful. The constancy of the results is remarkable. Calif lymph is used almost exclusively—in 99·95 per cent. of the vaccinations in the year 1897. (Over two millions vaccinated; no death directly caused, but 7 or 8 died from accidental wound-diseases).

supervision. If the Germans have 25 in a population of 54 millions, on the same scale we should require 18 in a population of 40 millions in the United Kingdom.

Opponents of vaccination attribute the success of Germany against small-pox to anything except vaccination. They assert:—

(a). That Prussia had compulsory vaccination before 1874. This is an error (see page 74).

(b). That great sanitary improvements were made about the year 1874, and afterwards. Error again. No sudden and striking improvement occurred in Germany, as compared with Austria. See page 88: “.....*all other conditions remain the same in the two countries*” (official text, Gesundheitsamt).

(c). That a severe isolation law was passed in 1883. This also is an error; no fresh ‘law’ was passed, but in an appeal case it was ruled that isolation in Prussia, by the old law of 1835, applies to the *whole house*, and not merely to the *apartments*, and a notification (‘Reichsgerichtserkenntniss’) of this was issued.

CHAPTER X.

SMALL-POX AND VACCINATION IN RECENT YEARS.

SECTION I.—DIRECT AND INDIRECT EVIDENCE.

GREAT attention has been paid of late years to the mortality caused by small-pox individually amongst the vaccinated and unvaccinated respectively. It is found that Vaccination makes an enormous difference in the mortality, and this difference constitutes the 'direct' proof of the protection given by Vaccination. So far in this work, the vaccinated or unvaccinated condition has been only incidentally referred to. The small-pox mortality by itself constitutes the *indirect* proof of the benefit of Vaccination, whether we examine the mortality in the same country at different periods, having regard to the vaccination laws of that country, or the mortality in various countries (under different vaccination laws, or with no such laws) at the same period.

1. *The same country at different periods.*

Small-pox, average rates yearly, per million living.

SWEDEN.

In prevaccination era, average rate about	2,000
Vaccination optional, 1802-11, average rate	623
Vaccination compulsory, 1857-66, average	
rate	176
Since 1880, vaccination more efficiently en-	
forced, average rate	2

ENGLAND.

Estimated rate in eighteenth century, average rate, not less than	...	...	...	3,000
Vaccination permissive, 12 years during 1838-53, average rate	...	...	...	417
Vaccination obligatory (nominally), 1857-66, average rate	..	...	...	214
Vaccination enforced under penalties, 1889-98, average rate	...	...	...	10

2. *Different countries during the same period.*

Five years, 1893-97, average rates (per million).

Spain, average of 4 years, 563. Russia, 463.

Belgium, 100. Austria, 99. France (towns), 90.

Netherlands, 39. Switzerland, 5.

England, 20. Scotland, 12. Sweden, average of 4 years, 2.

Germany, 1: (Italy, 73. Hungary, 134.)*

SMALL-POX MORTALITY, DURING A CENTURY OF VACCINATION IN EUROPE.

Deaths, per million of population, each year of various decades (*Author*).

Before Vaccination began.

Sweden, 1784-93.—5,826, 2,370, 313, 825, 2,544, 3,148, 2,740, 1,425, 880, 944. Average **2,101**.

* Italy and Hungary have now compulsory revaccination like Germany, and their rates have been rapidly lowered in consequence, but are still comparatively high because their vaccination systems are not fully organized. The average rate for Italy during the three years 1887-9 was 536 (!) and that of Hungary during five years 1884-8 was 518 (!)

After Vaccination began.1. *Vaccination permitted and encouraged.*

Sweden, 1802-11.—646, 613, 608, 452, 616, 688, 759,
1,009, 347, 291. Average **623**

[Spain, 1893-6.—Four years. Average **563**]

Prussia, 1854-63.—436, 97, 73, 133, 264, 196, 189,
302, 210. Average **224**

Austria, 1887-96.—440, 640, 520, 250, 290, 260, 250,
110, 47, 35. Average **284**

2. *Vaccination of infants obligatory :*

Sweden, 1857-66.—152, 345, 388, 183, 49, 37, 76,
182, 325, 293. Average **176**

England, 1857-66.—206, 335, 197, 140, 66, 81, 293,
373, 309, 144. Average **214**

Bavaria, 1857-66.—69, 32, 28, 16, 26, 23, 23, 46,
120, 250. Average **63**

And enforced under penalties.

England, 1889-98.—0·8, 0·6, 1·9, 14·7, 49, 27, 7,
17, 0·8, 8. Average **10**

[Netherlands, 1884-93 (Certificate of vaccination required,
since the year 1873, on entering school ; vaccination in in-
fancy optional).—15, 7, 17, 4, 0·2, 2, 0·2, 2, 11, 41.
Average **10**]

3. *Revaccination obligatory in 12th year (school children).*

Prussia, 1889-98.—5·4, 1·2, 1·2, 3, 4·4, 2·5, 0·8, 0·2,
0·2, 0·4. Average **2**

German Empire, 1889-98.—4·1, 1·2, 10, 2·1, 3·1, 1·7,
0·5, 0·2, 0·1, 0·3. Average **1·4**

4. *Thrice-vaccination, viz., in infancy, in school-age,
and in the army.*

Prussian Army.—2 deaths in 25 years, 1875-99.
First death in 1884, a reservist twice unsucces-
fully vaccinated in the army.

The proof is indirect, but *the data are reliable*. We know that the deaths happened, and we know the state of the law in various countries, also in most cases we know approximately how far the law was carried out. We find in all times and in all places, a reduction of small-pox mortality corresponding to the amount of vaccination. This is a negative proposition—there is not so much small-pox—and if the statistics referred only to one country doubts might justly be raised. But it applies everywhere, and in every period since vaccination came into use; thus this indirect proof is firmly established *by its universality*. The German Vaccination Commission of 1884 relied solely on this proof, and it is the proof mainly relied on in the recent Denkschrift of the k. k. Gesundheitsamt, in Berlin.

‘Directly the question of the vaccination or non-vaccination (of individuals) arises’—said Dr. Koch in 1884—‘room is afforded for a number of errors; in fact, this is the reason why the original returns (of the epidemic of 1872) are not laid before the Commission. To begin with, the information as to whether anyone who has died of small pox had been vaccinated or not, is given by the friends of the deceased, and not, in the majority of instances, by medical men. Again such statistics do not state (1) whether the vaccination was successful or not, but merely the fact of vaccination; (2) the degree of success—the number of vesicles produced; and lastly (and most important) (3) the date of vaccination. This is most important, because we are all agreed that vaccination does not protect indefinitely, and it is a very different matter to me whether a man has been vaccinated five years, or fifty years previously. As to the patients’ friends they always lean to an affirmative reply. But lastly, even if we have all this information accurately given, we should require to know, in order to satisfy the demands of such statistics, not only the proportion of the vaccinated to the unvaccinated amongst those who die of small-pox at different ages, *but also the same proportion among the living population*. Now this proportion it is impossible to obtain, and even if obtained for one day, it would

not hold for the next day, so shifting are the conditions as regards population.

‘The mortality from small-pox is the only secure basis of a national statistic, if this ever errs, it is on the side of excess.’

Von Scheel supported this statement by examples for the years 1881-2. The small-pox deaths returned to the Statistical Office were 1,473 and 1,330 for these two years respectively, but on verification, the numbers were reduced to 979 and 957, *i.e.*, 66 per cent. and 75 per cent. respectively. ‘This excess tells not against the vaccination law but for it, because it was more appreciable in reference to the fewer deaths after the law than before it, *i.e.*, the true numbers contrast still more strongly. The error is never the other way; no small-pox deaths are ever returned as due to other diseases.’

Such being the case with regard to statistics, Koch went on to argue that all the greater importance attached to *personal experience* (the direct proof), and this he himself relied on to a great extent. He had seen much small-pox, and had vaccinated and revaccinated thousands of persons, and had arrived at the profound conviction that vaccination protected against small-pox. His own personal experience might not be considered worth much, but when it was corroborated by the vast experience of those who were familiar with small-pox, it became important. Medical experience in other diseases was allowed its full weight, why not here?

Such were Koch’s observations in presenting the official statistics. ‘Personal conviction’ rests on direct evidence. In the medical profession, it may be said in general that this *personal conviction* derived from observation of the actual behaviour of small-pox amongst

the vaccinated and unvaccinated respectively, is the strongest factor which compels this firm belief in the power of vaccination against small-pox.

On the other hand, as to the statistical part of the direct proof, based on the incidence and mortality of small-pox amongst the vaccinated and unvaccinated respectively, the evidence is direct, but the *data*, if on a large scale, and unless carefully obtained, are for the most part unreliable and incomplete. Incomplete, because we cannot know the vaccinated condition of the whole population, and unreliable for the most part, if the information is obtained by persons not all trained to observe, from persons not all truthful, viz., the general public. But such direct evidence, when reliable, constitutes an unanswerable argument in favour of vaccination, and as regards certain strictly defined sections of the community, *e.g.* the army, the police, post-office employees, nurses and attendants in small-pox hospitals, *abundant evidence of a reliable character has now accumulated, directly proving the protective influence of vaccination against small-pox.* Further, the enquiry into the vaccinated condition of each individual has been made by special census, with a fair degree of exactitude, amongst the populations of separate towns, during epidemic periods in recent times, beginning with Dr. Flinzer's 'Statistics of the Town of Chemnitz, in Saxony, during the epidemic of 1871-2.' These statistics form a model of their kind for later observers, and may be abridged as follows:—

SECTION 2.—STATISTICAL DIRECT EVIDENCE.

A.—Towns.

Chemnitz. (1870-1, Dr. Flinzer).

A special census of this town in Saxony, was made at Dr. Flinzer's suggestion. Population, 64,255; vaccinated persons, 53,891 (84 per cent.); not vaccinated, 5,712 (9 per cent.); 'survivors,' 4,652 (7 per cent.). The small-pox attacks numbered 3,596; the deaths, 249. Only 9 in 100 of the population were unvaccinated, and yet this small part furnished most of the cases and nearly all the deaths; viz., 2,643 attacks and 242 deaths. *The seven deaths in the vaccinated all belonged to ages above childhood.* On the other hand the deaths amongst the unvaccinated were nearly all deaths of children under 10; 209 under 5 years.

Under 10 years:—vaccinated deaths, none; unvaccinated, deaths, 220. Above ten years:—vaccinated, deaths 7; unvaccinated, deaths 22.

The attack rate in the protected (including 'survivors') was 1·6 per cent.; in the unprotected 46·3 per cent.! This is an extremely important instance.

Vaccination was not compulsory in Saxony.

Bavaria and Hesse. The Netherlands.

The figures for **Bavaria** during 1871 will here be given, because attention has already been drawn to the fact that almost the whole population above childhood

consisted of vaccinated persons. Bavaria adopted compulsory vaccination in 1807, and suffered far less than countries without compulsory vaccination, during 1871-2, as already shown. We learn from Klinger that, taking the cases first, of 28,081 persons attacked, 906 were infants under one year; 23,047 were adults over 20 years old, and only 4,128 were in the age-class 1-20 years. Next as to the deaths, which were **4,371**, we find that 601 infants under one year, and therefore under the usual age for vaccination, died of small-pox; *only 250 in the age-class 1-20 years*, 1,919 aged 20-50, and 1,601 over 50 years. Thus if we exclude the class under 1 year, then 85 per cent. of the remaining deaths occurred at ages above 20 years, when the protection of vaccination had lapsed.

Hesse in 1870-2 shows a similar result. Here also vaccination was early made compulsory, and we find that the age-class comprising childhood and early adult life was the least affected, if we exclude infants under 1 year. The 1,441 deaths from small-pox in Hesse occurred at the following ages:—

Under 1 year, 222; 1-5 years, 43; 5-10 years, 15; 10-20 years, 35; 20-30 years, 179; 30-60 years, 763; over 60 years, 184.

Here we see that in a vaccinated population the mortality falls chiefly upon advanced adult ages.

In the **Netherlands**, 1870-3, there was *no compulsory vaccination* law of any kind, and *a remarkable contrast to the above* is apparent from the following:—

The deaths (20,572) fell as follows:—Under 1 year, 3,263; 1-5 years, 6,551; 5-10 years, 2,277; 10-20 years, 1,957; 20-30 years, 2,000; 30-60 years, 4,084; over 60 years, 440.

Here the age-class 1-5 years shows more deaths than any other age-class. (See page 82).

These results are compared more clearly in the following table of small-pox deaths (actual).

Age in Years.	Netherlands. 1870-3.	Hesse. 1870-2.	Bavaria. 1871.
0- 1	3,263	222	601 (0- 1)
1- 5	6,551	43	250 (1-20)
5-10	2,277	15	
10-20	1,957	35	
20-30	2,000	179	1,919 (20-50)
30-60	4,084	763	1,601 (Above 50)
Over 60	440	184	

The Official Report of the Epidemic in the Netherlands (Ministry of the Interior), states that of 4152 small-pox attacked under 5 years old, only 543 were vaccinated (about 1 in 100), which is a direct contradiction to Vogt's statement on the subject.

Thus the Netherlands differ from Hesse and Bavaria, both which countries had compulsory vaccination.

LEIPSIG DISTRICT, 1870-2. (Siegel).

Dr. Siegel's Statistics of 106 villages and places in the neighbourhood of Leipzig, were based on fortnightly returns sent in by the medical men, the 'vaccinated condition' being medically ascertained in each case; 3,881 cases and 721 deaths occurred; of these 3,846 cases with 705 deaths were statistically verified, and of these the cases and deaths in the following table were all reported by medical men.

Age in Years.	ATTACKED.		DIED.	
	Unvaccinated.	Vaccinated.	Unvaccinated.	Vaccinated
0- 1	280	0	159	0
1- 2	308	2	126	0
2- 3	315	8	97	0
3- 4	153	17	44	1
4- 5	119	13	27	1
5-10	143	92	30	4
10-20	40	319	7	6
20-30	13	557	9	25
30-60	17	1,166	7	145
Above 60	7	56	2	15
	<hr/>	<hr/>	<hr/>	<hr/>
Total	1,395	2,230	508	197

The reader will note the contrast between the two columns of the attacked. The 3,846 cases with 705 deaths were divided into two age-classes.

Under 15 years of age, 1,384 unvaccinated cases, with 488 deaths; fatality 35 per cent. 280 vaccinated cases, with 8 deaths; fatality 3 per cent. nearly.

Above 15 years of age, 45 unvaccinated cases, with 20 deaths; fatality 44 per cent. 2,137 vaccinated cases, with 189 deaths; fatality 9 per cent. nearly.

Thus in the unvaccinated, the incidence and mortality affect chiefly children, but in the vaccinated most of the attacks, and nearly all the deaths occur at older ages, enforcing the lesson of the Chemnitz statistics.

LEIPSIG CITY, 1870-2. (Wunderlich).

In the City Hospitals up to Feb. 20, 1872, the cases were 1,727; viz., 139 unvaccinated, 22 'survivors,' 1,504 vaccinated, and 62 doubtful. Of the 139, the fatal cases were 99 (71 per cent.), of the 22 survivors from previous small-pox, 6 died (23 per cent.), of the 1,504 vaccinated,

116 died (8 per cent.); of 13 revaccinated cases, none were fatal.

Under 8 years of age, 98 **unvaccinated** cases with 69 deaths (70 per cent.); no **vaccinated** cases. 9-14 years of age, 11 **unvaccinated** cases, with 4 deaths; 20 **vaccinated** cases with no death. 15-24 years of age, 11 **unvaccinated** cases with 4 deaths; 801 **vaccinated** cases, with 23 deaths (3 per cent. nearly). 25 years of age and over, 18 **unvaccinated** cases, with 18 deaths (!); 673 **vaccinated** cases, with 89 deaths (13 per cent.).

Thus no death occurred of a vaccinated person under 14. These are not quite all the cases, a few are omitted of which the ages are not known. The reader must remember that, as Dr. Siegel pointed out to the German Commission, a very *low mortality* implies that the *majority* of the cases were *light*, and conversely a high mortality in any class indicates that most of the cases in that class were severe, even those which recovered. The above table shows that not only *no vaccinated children died of small-pox, but only 3 in 100 of those attacked in early adult life*, also that even at later ages, though the percentage mortality is higher than at younger ages, *it is still much below that of the unvaccinated cases*; thus vaccination protects against death by small-pox long after it has ceased to protect against attack.

Note on Müller's Berlin Statistics.

Müller's Berlin Statistics are valueless; as Müller himself acknowledged at the Internat. Med. Congress in Vienna in 1873, adding that a medical examination had proved that no properly vaccinated child had ever

been proved to have died of small-pox in Berlin. These statistics are based on unreliable material, as to the vaccination condition of patients, viz., on answers of parents to the police. By the law of 1835, in Prussia *parents were liable to a penalty if their unvaccinated children had small-pox*. Apart from the incompleteness of the returns during the epidemic, the mere assertions of the parents were accepted as to the previous vaccination of their children, and this is the chief reason why the original returns of the epidemic period were not laid before the German Commission of 1884. In spite of this, opponents of vaccination, e.g., Lorinser and Vogt, have made much of these statistics. As an example of the incompleteness of Müller's figures, the 'Berliner Statistischen Jahrbuch' gives 1,664 more small-pox deaths than those mentioned by Müller.

Guttstadt, a reliable observer, carefully went over the same ground, but his estimates of the number of the vaccinated population in Berlin are not established. (Guttstadt, 'Die Pockenepidemie im Preussen').

In Switzerland, the enquiries of Brunner and Zehnder (following Lotz), show that *no vaccinated person under 19 years died of small-pox*, in the epidemic of the early seventies.

SHEFFIELD EPIDEMIC, 1887-8. (Dr. Barry).

A special census was made, to ascertain the number of the vaccinated, and it was found that only about 2 in 100 of the inhabitants were *not vaccinated*. The word of each person questioned was accepted, but making every allowance, the vaccination registers shewed that at least 95 in every 100 were vaccinated. Yet the small unvac-

cinated part of the population sustained most of the deaths (274), as compared with the deaths of vaccinated persons (200). Excluding children under 3 months; one vaccinated child under 5 died, but 66 unvaccinated under 5 died of small-pox.

Children under 10 years of age :—Deaths per cent. of attacks in the vaccinated 1·7; in the unvaccinated 44. Age-class above 10 :—Deaths per cent. of attacks in the vaccinated 5; in the unvaccinated 54.

SIX RECENT EPIDEMICS.

(Final Report of Royal Commission).

1891-2, *Dewsbury*—Under 10 years of age, vaccinated 44 attacks, 1 death; unvaccinated 174 attacks, 56 deaths (32 per cent.). Above 10 years of age, vaccinated, 577 attacks, 15 deaths, 2·6 per cent.; unvaccinated, 192 attacks, 36 deaths, 18·7 per cent.

1892-3, *Warrington*—Under 10 years of age, vaccinated 33 attacks, 2 deaths; unvaccinated, 32 attacks, 12 deaths, 37·5 per cent. Above 10 years of age, vaccinated, 560 attacks, 36 deaths, 6·4 per cent.; unvaccinated, 36 attacks, 12 deaths, 33 per cent.

1892-3, *Leicester*—Under 10 years of age, vaccinated, 2 attacks, 0 deaths; unvaccinated, 107 attacks, 15 deaths, 14 per cent. Above 10 years of age, vaccinated, 197 attacks, 2 deaths, 1 per cent.; unvaccinated, 51 attacks, 4 deaths, 7·8 per cent.

1892-3, *London (A)*—Under 10 years of age, vaccinated, 39 attacks, 0 deaths; unvaccinated, 23 attacks, 13 deaths. Above 10 years of age, vaccinated, 175 attacks, 3 deaths, 2·3 per cent; unvaccinated, 16 attacks, 1 death.

1892-3, *Gloucester*—Under 10 years of age, vaccinated, 26 attacks, 1 death; unvaccinated, 680 attacks, 279 deaths, 44 per cent. Above 10 years of age, vaccinated, 1,185 attacks, 119 deaths, 10 per cent.; unvaccinated, 88 attacks, 35 deaths, 40 per cent.

1892-3, *London (B)*—Under 10 years of age, vaccinated, 71 attacks, 0 deaths; unvaccinated, 205? attacks, 148 deaths, 72 per cent. Above 10 years of age, vaccinated, 1,468 attacks, 36 deaths, 2·4 per cent.; unvaccinated, 165 attacks, 37 deaths, 23·6 per cent. (A second epidemic).

The Gloucester Epidemic.

40,000 inhabitants, 1,979 cases, 434 deaths.

The one vaccinated child who died was a girl four years old. The vaccine crusts were still on the arm when she was attacked by small-pox.

Of 1,168 vaccinated, 102 died, 8·7 per cent.; of 40 said to be vaccinated (no cicatrices) 16 died; of 3 doubtfully vaccinated, 2 died; of 89 vaccinated too late (after infection), 27 died; of 679 not vaccinated, 287 died, 42 per cent.

In round numbers the small-pox death-rate during the epidemic was over 10,000 per million, and would doubtless have been far higher but that the anti-vaccinists at last gave way, and compulsory vaccination was again adopted, on March 24. This soon abated the epidemic. In each successive fortnight after March 29, the fresh cases numbered 404, 334, 197, 75, 105, 36. During the epidemic, in the first half of the year 1896, the primary and revaccinations were 8,484 and 26,332 respectively, together 34,836 in a population of about 40,000. So the plague was stayed.

Careful personal observation of the dwellers in 899 households was made, as to their vaccinated condition. The cases in which persons were vaccinated too late, *i.e.*, when already infected, are excluded from the following :—

In the first year of life, of 14 vaccinated, 0 were attacked; of 86 not vaccinated **70** were attacked (attack rate 81 per cent.).

Age 2-10 years, of 258 vaccinated 24 were attacked (9 per cent.); of 628 not vaccinated **471** were attacked (75 per cent.).

Age 11-30, of 1,649 vaccinated 599 were attacked (33 per cent.); of 63 not vaccinated 47 were attacked (75 per cent.).

Above 30 years, of 1,465 vaccinated 465 were attacked (32 per cent.); of 35 not vaccinated 16 were attacked (46 per cent.).

It is found that on adding together the several numbers of individuals belonging to infected houses in various recent epidemics, of 5,173 vaccinated children under 10 years, 8 died (**1 in 646**); but of 1,541 unvaccinated children under 10 years, 383 died (**1 in 4**).

The above two classes were equally exposed to the infection, so were the following, of 19,028 vaccinated persons above 10 years, 299 (1·6 per cent.) died of small-pox (**1 in 60**); of 1,065 unvaccinated persons above 10 years, 227 (21·3 per cent.) died of small-pox (**1 in 4** nearly).

For many years previous to the epidemic, vaccination had been almost in abeyance in Gloucester, and the inhabitants lived in a fools' paradise.

SPECIAL CLASSES OF THE COMMUNITY.

Nurses in small-pox hospitals are in the very focus of the contagion of small-pox.

‘During the epidemic of 1871, there were 110 persons engaged in the Homerton Fever hospital, in attendance on the small-pox sick; **all these with two exceptions, were revaccinated, and all but these two escaped small-pox.**

‘The experience of the epidemic 1876-7 was of the same kind; all revaccinated attendants having escaped, whilst **the only one who had not been revaccinated took small-pox**, and died of it.’ (Dr. Collie, in ‘Quain’s Dictionary of Medicine’).

A Committee appointed by the Epidemiological Society to examine into and report on these statistics of nurses, reported that:—(A) of 1,500 persons in practical attendance on cases of small-pox, 43 contracted small-pox, ‘and not one of these 43 had been revaccinated.’ (B) of **734** nurses and attendants in the Metropolitan Asylums Board Hospitals, 79 were survivors from small-pox attack, they escaped infection; 645 were revaccinated on entrance, they all escaped, 10 were not revaccinated, *and the whole 10 took small-pox.*

BRITISH ARMY.

Small-pox deaths per 100,000 of strength (except Egypt).

A. Home Army.

1847-58:—10, 16, 32, 7, 8, 21, 22, 45, 38, 4, 10, 18.

1858 *Order*:—All recruits to be vaccinated on joining.

1859-78:—10, 7, 4, 4, 8, 14, 8, 1, 1, 3, 0, 1, 23, 14, 1, 0, 1, 2, 4, 1.

1879-99:—0, 0, 2, 1, 0, 0, 3, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

B. India.

1860-79:—29, 61, 8, 18, 29, 26, 10, 9, 0, 32, 9, 2, 19, 19, 13, 3, 0, 3, 23, 6.

1880-94:—2, 2, 7, 16, 14, 0, 2, 3, 15, 25, 6, 2, 4, 6, 4.

C. Egypt (*actual deaths*).

1882-9:—(Force never reached 10,000 except in year 1886). 0, 3, 1, 4, 3, 4, 4, 6.

D. Colonies.

No death during period 1881-94.

BRITISH NAVY.

Small-pox deaths per 100,000 of strength.

1871 Order:—All to be vaccinated on joining, except natives joining abroad.

1873 Order:—All to be vaccinated on joining.

1860-69:—39, 38, 31, 28, 62, 29, 16, 27, 4, 10.

1870-79:—2, 25, 23, 2, 2, 2, 13, 0, 0, 31.

1880-89:—2, 7, 5, 0, 0, 0, 6, 0, 2, 2.

1890-99:—4, 0, 3, 0, 0, 0, 0'4, 0'4, 0'4, 0'4.

FRENCH ARMY.

Small-pox deaths per 100,000 of strength.

1872-88:—8, 4, 3, 18, 21, 19, 20, 9, 15, 8, 8, 3, 3, 1, 3, 3.

1888:—All recruits to be revaccinated on joining. Reorganisation of vaccination in the army.

1889-98:—4, 0'7, 0'5, 0'2, 0'7, 1, 1, 0'5, 0'2, 0'4.

AUSTRIAN-HUNGARIAN ARMY.

Small-pox deaths per 100,000 of strength.

1870-85 :—17, 40, 101, 100, 67, 21, 10, 25, 15, 23, 25, 29, 28, 16, 8, 12.

1885 :—All recruits to be revaccinated on joining. Re-organisation of army vaccinations.

1886-98 :—8, 3, 2, 2, 0·4, 0·7, 0·0, 0·3, 0·3, 0·7, 0·3, 0·2, 0·4.

PRUSSIAN ARMY.

Small-pox deaths per 100,000 of strength.

1867-74 :—0·8, 0·4, 0·4, (1870-1) 33, (1871 second half) 28, (1872) 6, (1873-4) 3.

1875-99 :—Only two deaths in 25 years, viz., 1 in 1884 and 1 in 1898.

See pp. 58-60, for an account by Dr. Werner, of the army order of 1834.

GERMAN ARMY (1870-2).

Analysis of attacks, 1,005 in number (deaths 60), of which details are known.

Not revaccinated—531 attacks, 46 died, fatality 8·6 per cent.

Revaccinated successfully—109 attacks, 2 died, fatality 2 per cent.

Revaccinated unsuccessfully—224 attacks, 10 died, fatality 4·4 per cent.

Revaccinated, result unknown—130 attacks, 1 died, fatality 0·7 per cent.

Revaccinated, result doubtful—7 attacks.

Unvaccinated—4 attacks, 1 died.

Thus of 60 deaths, almost one-fourth of the whole small-pox mortality of the German Field Army, only two occurred in the successfully revaccinated, whilst 57 occurred in the non-revaccinated and unsuccessfully revaccinated together. Now these two classes constitute a very **small part of the German Army**, yet here we find that they **sustained nearly all the deaths**.

Survived small-pox itself is not an absolute protection against a future attack, which may even be fatal. Dr. Friedberg, cited by Lotz ('Pocken und Vaccination,' Basle, 1880) reported an extraordinary (unique?) case from near Breslau, during the severe epidemic of 1871-2. A child had small-pox and the attack left several cicatrices; the child was vaccinated successfully some months afterwards, and then contracted small-pox a second time, one month after the vaccine crusts had fallen, and the second attack was fatal.

Again, Dr. Savill (Warrington epidemic 1892-3) reports a woman, ætat. 30, vaccinated in infancy (foveate area of scars = $\frac{1}{4}$ inch), successfully revaccinated in 1873 (ætat. 10, foveate area of scars = $\frac{1}{2}$ inch), contracted small-pox 'about, probably at, the same time,' and yet twenty years afterwards had a severe attack of confluent small-pox (April, 1893), 'which resulted in her face being badly pitted.' Here there was an interval of twenty years between the revaccination and the second attack of small-pox. There were many 'survivors' in Warrington, and some of them had a second attack of small-pox during the epidemic, 1892-3. 'The attack rate (11.1 per cent.) in the infected houses amongst the revaccinated was a little less' than the attack rate (12.2) amongst those who

had already gone through an attack previously to the epidemic. 'The figures (7 and 5 cases respectively) are small, but the point is worthy of note.'

POST OFFICE EMPLOYEES.

All persons engaged in the Postal Service are required to be revaccinated, and death by small-pox is unheard of. Even in the great epidemic of 1871-2 there was not a single death amongst over 10,000 employees, and there were only ten slight cases.

The same is true of the Police, and of any other bodies of men where revaccination is required, *e.g.*, the various branches of the Civil Service, (apart from the Post Office) the Army, the Navy.

SPECIAL INSTANCES.

These may be adduced *ad libitum*. Dr. Eulenburg in 1884 related the instance that during the epidemic, 1870-2 a manufacturer in Posen had all his workmen vaccinated, except one who refused. This man alone of the 150 soon afterwards contracted small-pox, and died of it.

In the Warrington epidemic, 1892-3, the only two persons connected with the Aikin Street Hospital who were attacked were two who were not revaccinated with the rest at the beginning of the outbreak (Dr. Savill's Report).

Körösi—'Kritik d. Vac. Statistik,' Berlin, 1889—cites a report of Dr. Vollerich, Budapest Garrison, when revaccination began in the Austro-Hungarian Army in 1886. In October 250 recruits joined the garrison,

249 were vaccinated ; one was exempted owing to an abscess. This one contracted small-pox at the end of October, and no others of the garrison were infected. All, apart from the 250, had been vaccinated at the end of the previous year.

CHAPTER XI.

THE ROYAL COMMISSION; AND THE GREAT SURRENDER.

FOR some years after the epidemic of 1871-2 public vaccination was vigorously conducted, under the law of 1871, which amended the law of 1867. But soon a strong opposition arose, and increased as prosecutions for neglect of Vaccination became more numerous, and especially as fines were repeated. Within ten years, 1880-9, more than 11,000 penalties had been inflicted, 115 were imprisonments. The Boards of Guardians of many Unions openly refused to prosecute for non-compliance with the Law, and this encouraged resistance in other Unions. It was not wise of Parliament to entrust the question of prosecution or non-prosecution—in an Imperial measure affecting the public health—to isolated local authorities, elected by popular vote in each parish to administer the Poor Law, which has nothing to do with Vaccination; and who act the more independently inasmuch as they are not paid officials but give their services voluntarily.

In London the vaccination default was but slight in 1881, but reached 10 per cent. in 1888, and approached 20 per cent. in 1892; a very serious deficit.

In 1885 the official German statistics laid before the German Vaccination Commission of 1884 were published in this country. They showed the effect of the law of 1874 which made obligatory throughout the

German Empire, not only compulsory vaccination in infancy in those kingdoms of the Empire *which hitherto had no such compulsory vaccination, e.g., Prussia*, but also the revaccination of all school children of the age of 12 throughout the Empire. It was made plain that epidemic outbreaks of small-pox were in a very few years abolished utterly,

In 1887-8 the severe **Sheffield** outbreak was investigated for the Local Government Board by Dr. Barry, and for the first time in England 'direct' statistical evidence of vaccination-protection in a large city during an epidemic was obtained—owing to a special census—even more thoroughly than in Chemnitz.

In 1889 a Royal Commission was appointed 'to enquire and report as to—

'1. The effect of Vaccination in reducing the prevalence of, and mortality from, small-pox.

'2. What means, other than Vaccination, can be used for diminishing the prevalence of small-pox, and how far such means could be relied on in place of Vaccination.

'3. The objections made to Vaccination on the ground of injurious effects alleged to result therefrom and the nature and extent of any injurious effects which do in fact result.

'4. Whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from Vaccination, and whether, and, if so, by what means, Vaccination with animal Vaccine should be further facilitated as a part of public Vaccination.

'5. Whether any alterations should be made in the arrangements and proceedings for securing the per-

formance of Vaccination, and in particular in the provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the Law.'

The following were the members originally appointed (15):—Lord Herschell, the Lord Chancellor of England, Chairman; Sir James Paget, F.R.C.S.; Sir Charles Dalrymple, Bart.; Sir William Guyer Hunter, F.R.C.P.; Sir E. H. Galsworthy; W. S. Savory, F.R.C.S.; Charles Bradlaugh; J. S. Bristowe, F.R.C.P.; W. J. Collins, F.R.C.S.; J. S. Dugdale, Q.C.; (Prof.) Michael Foster, M.A.; Jonathan Hutchinson, F.R.C.S.; A. Picton; Samuel Whitbread; and F. Meadows White, Q.C. In April, 1889, Mr. J. A. Bright was appointed in place of Mr. Bradlaugh, deceased.

The Final Report of the Royal Commission appeared in August, 1896, seven years after its appointment. It bore eleven signatures (Herschell, Paget, Dalrymple, Hunter, Galsworthy, Dugdale, Foster, Hutchinson, Meadows, White, Whitbread, and Bright). This Report, together with the interim Reports and Appendices, constitutes a mine of information upon every subject connected with vaccination and small-pox.

RECENT EPIDEMIC OUTBREAKS.

Special points.

While the Commission was engaged in its labours, several localized epidemic outbreaks of small-pox occurred, and the Commission sent out medical men to furnish special reports. These valuable reports amply confirm the Chemnitz, Sheffield, and Leipsig statistics. It is not the purpose of the writer to give a

detailed analysis of the Final Report, which is an immense document, but only to select what is of importance for the history of small-pox and vaccination. The special reports of epidemics of small-pox are of special importance, and these and some other main results embodied in the Final Report will first be given, before proceeding to the chief conclusions of the Commission.

LONDON EPIDEMIC (1892-3).

Dr. Luff reported on two outbreaks, and took special care to ascertain the proportion of the really vaccinated amongst the attacked. Out of 2,353 total attacked at all ages, 409 were not vaccinated, *i.e.*, 17 per cent. But when the age under 10 is considered, a startling result appears, for out of 358 children attacked, 228 were not vaccinated, proportion nearly 64 per cent. 'It is not open to doubt'—the Commissioners say—that this was greatly in excess of the percentage of unvaccinated persons under ten years of age in London, or in any part of it.'

Again, in the Homerton Hospital, out of 2,493 admissions under 10, *no less than 47 per cent. were unvaccinated persons*. This is very far from the proportion of unvaccinated amongst the general public in the period of the admissions, *viz.*, 1873-1885.

Also Fulham Hospital 370 admissions, 168 not vaccinated, 45·4 per cent. The Highgate Hospital shows a different proportion. But this Hospital is not used by the Metropolitan Asylums Board for their cases. It is only used for paying patients, and the *unvaccinated admissions are consequently few*; further, *no*

children under 7 are admitted, thus the Highgate Hospital does not afford a fair test.

Warrington and Sheffield had enjoyed good vaccination previously—the Sheffield epidemic of 1887-8 is alluded to—but London had fallen off, so that during the years 1883-91 the percentage of children unaccounted for as to vaccination was 10. As to Dewsbury, Gloucester, and Leicester, vaccination was extremely neglected, *e.g.*, in Dewsbury, the vaccination deficiency in 11 years, 1882-92, fell to 32 per cent., Gloucester sank from 10·6 deficiency in 1885 to 85 in 1894. Leicester's default was already 44 (nearly) in 1883, and vaccination then fell into abeyance there. So that London was intermediate in vaccination default between Warrington and Sheffield on the one hand, and Dewsbury, Gloucester, and Leicester, on the other.

The percentages of the total small-pox mortality which were borne by the age-class 0-10 years, in the epidemics in these towns respectively are:—

Warrington. Sheffield. London.			Dewsbury. Gloucester. Leicester.		
22·5	25·6	37 nearly	52	64	71

London, exactly intermediate in vaccination default, is intermediate also in mortality under 10 years. Indeed, according to opponents Sheffield ought to have shown a higher mortality than Leicester, for they declared Sheffield an unhealthy, and Leicester a healthy town.

Taking a broad view of a century of vaccination in England, while before vaccination was introduced very nearly all the small-pox deaths were deaths of children, in the middle of the last century the proportion was nearly $\frac{7}{10}$. By the early seventies the proportion was reduced to $\frac{3}{10}$ and during the years 1885-9 was quite $\frac{2}{10}$,

but in 1890-4, through desuetude of vaccination, in many parts it rose to a little under $\frac{3}{10}$.

SCOTLAND BEFORE AND AFTER 1864. INFANTS.

In *Scotland* vaccination was made compulsory in 1864, six months being the age for vaccination, not three months, as in England till recently.

During 9 years, 1855-63, before compulsory vaccination, the age-class under 6 months furnished 139 in every 1,000 total small-pox deaths; also during 24 years, 1865-88, after compulsory vaccination began, the same age-class—the first half year of life—showed almost exactly the same proportion, viz., 138 in 1,000. But when we compare the proportions contributed by the age-class 6-12 months, *i.e.*, in the *second half-year of life*, in the two periods mentioned, we find a striking difference, viz., before compulsory vaccination 153, afterwards 47 per thousand. And if we take the age-class 1-5 years, the earlier contribution is 413, the later is 137 per thousand. This shows conclusively that improved sanitation cannot have caused the change, which is due exclusively to vaccination.

FATALITY OF VACCINATED AND UNVACCINATED.

In the *Sheffield* statistics, the following is a comparison between the fatalities of the vaccinated and unvaccinated respectively, first at all ages, and then in the age-class 'under 10.'

All ages:—Vaccinated: attacked, 4,151; died, 200; fatality nearly 5 per cent. Unvaccinated: attacked, 552; died, 274; fatality nearly 50 per cent. Ratio of the fatalities, 1 : 10.

Under 10:—Vaccinated: attacked, 353; died, 6; fatality, 1·7 per cent. Unvaccinated: attacked, 228; died, 100; fatality, 43·9 per cent. Ratio, 1 : 26.

Thus the difference between the fatalities of the vaccinated and unvaccinated respectively is more marked in childhood, *i.e.*, the nearer we approach the age for vaccination. The Commissioners remark on these statistics that:—‘Full allowance for possible errors does not modify the conclusion derivable from them.’

London, 1892-3.—Dr. Luff discarded all ‘doubtful’ cases from the following statistics of the attacks and deaths (the latter in brackets).

Above 10:—Vaccinated, 1,643 (39) = 2 per cent. Not vaccinated, 181 (38) = 21 per cent.

Under 10:—Vaccinated, 110 (0) = 0 per cent. Not vaccinated, 228 (61) = 27 per cent.

Here there was not one death in 110 attacks, in undoubtedly vaccinated children, while there were 61 deaths in 228 unvaccinated attacked.

In *Dewsbury* (1891-2) Dr. Sidney Coupland, who reported the epidemic, added all the cases of doubtful vaccinations to the vaccinated class, which is thereby handicapped, yet a similar result comes out.

Above 10:—Vaccinated, 577 (15) = 2·6 per cent. Unvaccinated, 192 (36) = 18·7.

Under 10:—Vaccinated, 44 (1) = 2·2 per cent. Not vaccinated, 174 (56) = 32·1 per cent.

See page 105 for similar statistics for Warrington, Leicester, and Gloucester.

The Commissioners justly regard the above statistics as an unanswerable argument for the protective influence of vaccination.

There is one point which the Commissioners do not notice. It has been strongly urged by opponents that unvaccinated children die more readily of small-pox, not because they are unvaccinated, but because they are a weaker class than the vaccinated, being in fact not vaccinated on account of their ill-health. But in Dewsbury, Leicester, and Gloucester public vaccination had fallen into abeyance altogether many years before the occurrence of the small-pox outbreaks. Therefore in these three towns it cannot be urged that the unvaccinated class was a weakly one as compared with the vaccinated; yet the same contrast in the fatalities is always found, especially in the age-class 'under 10.' Indeed, according to anti-vaccinists, the proportions ought to be reversed, for they assert that vaccination does children harm, as we hear daily from misguided conscientious objectors, who apply to magistrates for exemption of their children from vaccination.

The Commissioners take all the six towns together, and make a comparison by deducting the class 'said to be unvaccinated' from the total.

A.—ALL AGES.

		Deaths.	Fatality.
Total attacked	- - - 11,065	1,283	11.5 per cent.
Deducting unvaccinated attacked	2,321	822	35.4 „
Remainder	- - - 8,744	461	5.2 „

Why should this 'remainder' show such a remarkably low fatality? What else is there besides vaccination to account for the difference?

B.—ABOVE 10 YEARS.

		Deaths.	Fatality.
Total attacked	- - - 9,001	744	8.2 per cent.
Deducting unvaccinated attacked	870	299	34.3 „
Remainder	- - - 8,131	445	5.4 „

C.—UNDER 10 YEARS.

		Deaths.	Fatality.
Total attacked	- - - 2,038	539	26·4 per cent.
Deducting unvaccinated attacked	1,449	523	36·0 „
Remainder	- - - 589	16 (!)	2·7 „

The result is thus still more remarkable in childhood. What mysterious cause makes the fatality so low in the ‘remainder’ if vaccination is of no use?

But small-pox is very fatal under 1 year; rejecting all cases under 1 year, the following is the result:—

1-10 years:—Vaccinated attacked, 570 (17) = **2·8** per cent. fatality. Not vaccinated attacked, 1,235 (357) = **30·3** per cent. fatality.

Here again all doubtful cases are put with the ‘vaccinated,’ yet though the latter class is thus handicapped, there is an enormous difference in the fatalities of the vaccinated and not vaccinated. ‘The doubtful cases in London alone account for 6 out of 16 deaths, and raise the fatality from 1·8 to 2·8 per cent.’

Dr. Gayton’s 10,403 cases at Homerton Hospital are given. The class ‘vaccinated’ includes ‘vaccination alleged, but no marks.’

‘Vaccinated’ cases, 8,234, with 869 deaths; 10·5 per cent. Unvaccinated cases, 2,169, with 938 deaths; 43·4 per cent.

Fatality rate in eighteenth century.

The Commissioners assert that there is no normal fatality rate in last century, for great differences are found in various epidemics. Similarly, there are great differences now, *e.g.*, Leicester rate, 12 per cent.; Dewsbury, 25 per cent.; Gloucester, 41 per cent.

WARRINGTON IN 1773, AND IN 1893.

A comparison.

In 1773, long before vaccination began, Warrington, with a population of 8,000, sustained a severe epidemic of small-pox, which caused 211 deaths (Rev. J. Aitken, 'Phil. Trans.' 1774). In 1893, with a population of 54,084, of whom 53,654 were vaccinated persons, an epidemic caused 62 deaths. The following is a table of the ages at which these deaths occurred.

Age in years.	1773.	1893.	
		Vaccinated.	Not Vaccinated.
0- 1	49	0	8 (under 1 month).
1- 2	84	0	1
2- 3	33	0	0
3- 4	18	0	1
4- 5	15	0	1
5- 6	4	0	0
6- 7	2	0	0
7- 8	2	0	0
8- 9	4	1	1
9-15	0	1	1
15-20	0	1	2
20-30	0	10	4
30-60	0	24	5
Over 60	0	1	0
	<hr/>	<hr/>	<hr/>
	211	38	24

In 1773, more than nine-tenths of the deaths occurred at ages under 5, and *all were 'under 10.'* In 1893, nearly all the deaths in the vaccinated belong to advanced adult ages. The above table shows the difference of age incidence more clearly, perhaps, than the bare statement of

the mortality 'under 10.' No vaccinated child under 8 was even attacked.

Turning attention to invaded houses we find the following facts:—

Invaded Houses.

In *Sheffield*, 18,020 vaccinated and 736 unvaccinated, at all ages, occupied houses invaded by small-pox; but only 23 per cent. of the former were attacked, 75 per cent. of the latter.

But the contrast is far more striking when children alone are considered, (under 10 years), *i.e.*, as we approach the age of recent vaccination. There were 4,439 vaccinated children, and 263 unvaccinated children in invaded houses in *Sheffield*; of the former, 353, nearly **8** per cent., were attacked, but of the latter 228, or **87** per cent. In other words, of the vaccinated 10 out of 11 escaped, of the unvaccinated 1 out of 8 escaped.

In *Warrington*, similarly the attack rates in the vaccinated and unvaccinated were: under 10: 4·4 and 54·5 respectively, but above 10: 30 and 57·6.

'I could ascertain,' Dr. Savill reports, 'no reason for the remarkable difference in the attack rate in the two classes, unless the fact of vaccination protected the vaccinated from being attacked by small-pox. Being members of the same families, they lived in the same houses, (which, be it noted, were of a remarkable uniform type), ate the same food, often did the same work, and were exposed to the same hereditary and other influences.'

The attack rates in invaded houses in the other

epidemics cited were, in the vaccinated and unvaccinated respectively:—Leicester under 10, 2·5 and 35·3, above 10, 22·2 and 47·6; Dewsbury under 10, 10·2 and 50·8, above 10, 27·7 and 53·4; Gloucester* under 10, 8·8 and 46·3, above 10, 32·2 and 50.

It appears from the Final Report that the figures for Gloucester had not been received by the Commission until the paragraphs relating to the other towns were already in type, but it was found that no alterations were required in the paragraphs beyond the calculation of the percentages, because the Gloucester figures tell exactly the same tale as the rest.

Revaccination.

Unsuccessful revaccination does not imply immunity from small-pox. Four persons thus vaccinated in Warrington contracted small-pox, the eruption appearing more than 14 days after the vaccination. One case, ætat 13, had four good vaccination marks, from infancy.

In Sheffield (1887-8) out of 830 soldiers all nominally revaccinated, 12 were attacked and one died. In all twelve the revaccination had been unsuccessful.

The single small-pox death in the Prussian army during a period of over 20 years after the year 1874 was of a reservist, *twice unsuccessfully revaccinated*. (See also p. 112).

The Commissioners bring out well the very strong protective power of a second vaccination. As an

* In 1891 the Secretary of the Anti-vaccination League informed the Royal Commission that Gloucester was a very clean town, in good sanitary condition, and with a low death rate. After the epidemic (1896) the anti-vaccinists changed their tune, and said that the city was very insanitary.

example, out of 64,431 revaccinated persons in Sheffield, only 27 (0·04 per cent.) were attacked by small-pox in the epidemic of 1887-8.

The Leicester nurses may be here mentioned, forty in number, viz.:—Twenty revaccinated afresh, fourteen ‘survivors’ or else previously revaccinated, and *six who refused vaccination. Of these six, five took small-pox*, and one of them died; of the remaining thirty-four, only one was attacked—a mild attack in a person who had been revaccinated ten years previously (M’Vail).

Number of Vaccination Marks.

Out of 20,000 now collected, the following are 6839 recent cases of small-pox, in which careful observations of vaccination marks were made in hospital.

No. of marks	1	:	1,357	cases	85	deaths,	fatality	6·2
„	2	:	1,971	„	115	„	„	5·8
„	3	:	1,997	„	75	„	„	3·7
„	4	:	1,514	„	34	„	„	2·2

There is certainly a difference in the fatality rates between those with four marks, and those with either one or two marks, but there is practically no difference between the two latter classes.

If vaccination is repeated at the end of childhood, then three marks appear to be ample—Koch thought two enough. There is a little of the old cicatrix theory about this zeal in counting marks, and measuring ‘foreate areas.’

Cow-pox an attenuated form of Small-pox.

The words of the Final Report are:—‘Taking all the various facts into consideration, we seem led to the

provisional conclusions that under certain conditions the tissues of the cow are able to transform small-pox into vaccine (*sic*), and that these conditions may be such as to lead to the transference being sudden and complete, that under certain other conditions the transference may be gradual and incomplete, and that under certain other conditions—and these seem most commonly to obtain—the transference into vaccine does not take place at all.’

Various Diseases—increase or decrease of. Comparison of period 1863-7 with the period 1883-7.

Syphilis.—The infantile mortality from this cause has increased nearly 25 per cent. *In Leicester the increase is 69 per cent.*

Cancer.—There is an apparent increase, which may be real, but ‘not a shadow of evidence to connect this with the practice of Vaccination.’

Erysipelas has decreased nearly 17 per cent. in England; but in *Leicester* has increased 41 per cent.

Dangers of Vaccination.

‘.....yet when considered in relation to the extent of Vaccination work done they are insignificant.’

Sanitary Improvements.

In discussing the spread of small-pox, the Commissioners say:—‘It resembles measles in this, that the spread of it is not connected with any particular sanitary fault.....There is no evidence in the history of

small-pox, either before or during the nineteenth century, to connect outbreaks of that disease in a special way either with imperfect removal of excreta, or with lack of air and light, or with deficient food, or with lack of personal cleanliness'.....'thus not like typhus or typhoid.'

Measles up to 1894 'have not declined' (*sic*) in England, and has rather increased in Ireland.

Scarlet fever showed no decline till about 1880, but a marked decline after that year. 'We think that..... isolation has largely contributed.....'

Typhus and typhoid have declined owing to improved sanitation.

The Registrar-General's Table of the period 1847-87 ('Rep. Roy. Com.,' vol. i.) is of great importance. During 1847-87, a fall of small-pox mortality occurred in England. This Table shows that *this fall occurred exclusively in the young*, whilst on the contrary there was a *rise of the small-pox mortality amongst adults*, a rise increasing with older ages, *i.e.*, the greater the length of time after vaccination. The period is divided into three parts.

MEAN ANNUAL DEATHS FROM SMALL-POX AT SUCCESSIVE LIFE PERIODS, PER MILLION LIVING AT EACH SUCH LIFE PERIOD (1847-87, England and Wales).

	All ages.	Under 5.	5-10.	10-15.	15-25.	25-45.	Above 45.
1847-53*	305	1,617	337	94	109	66	22
1854-71†	223	817	243	88	163	131	52
1872-87‡	114	242	120	69	122	107	47
		Fall 85	Fall 64	Fall 27	Rise 11	Rise 62	Rise 113
		per cent.	per cent.	per cent.	per cent.	per cent.	per cent.

* Vaccination permissive. † Vaccination obligatory: not enforced.

‡ Vaccination enforced under penalties.

The fall which has occurred in **fever** (typhus and typhoid) is, on the contrary, a fall **at all ages**, as might be expected, for the fall is due to *improved sanitation, which affects all ages alike*. The Table shows that 'improved sanitation' cannot be the cause of the fall of small-pox mortality which has occurred during the period 1847-87.

To go back once more to the era before Vaccination : in Geneva in the period 1580-1760, **96 per cent.** of all the small-pox mortality was *in age-class under 10* ; but in the years 1892-3 in London the corresponding percentage in the undoubtedly vaccinated is *nil*, in the unvaccinated 27. (Dr. Luff).

It is remarkable that the Commissioners have very little to say about Germany. There lies the object lesson made for us, but this is all that the Final Report contains on the subject—the statistics are not brought down later than 1881 :—

Sec. 384.—' Prussia.....in the period prior to 1874 there is no such contrast to be found such as is observable after that year.' (This is a Lord Chancellor way of writing : what is meant is that the period after 1874 presents a strong contrast to the period before 1874, as regards small-pox mortality.)

Sec. 350.—' Upon a review of all the information derived from other countries, which we have had an opportunity of considering, it appears to us not to contradict, but on the contrary, to confirm, the experience acquired in this country.'

THE CHIEF CONCLUSIONS OF THE ROYAL COMMISSION
(1889-96).

As regards the protection afforded against small-pox by vaccination 'we think—

'1. That it diminishes the liability to be attacked by the disease.

'2. That it modifies the character of the disease and renders it (*a*) less fatal, (*b*) of a milder and less severe type.

(Query. What is the difference between 'milder' and 'less severe.'?)

'3. That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination.

(A. B. was vaccinated at the age of two years and died at the age of 70; the protection of vaccination was greatest during the 68 years which *immediately*, without any interval, succeeded the operation of vaccination—*i.e.*, the protection of Vaccination is greatest after the operation of Vaccination. Lord Chancellor style again).

'It is impossible to fix with any precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years.'

As regards revaccination, 'we think—

'6. That revaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes and that to ensure the highest degree of protection which Vaccination can give, the operation should be at intervals repeated.'

The first of the above conclusions needlessly under-

states the case for Vaccination, and the third is needlessly vague. The Royal Commission might have used a simpler and more direct style. The following—they will bear repetition—are the conclusions of:—

THE GERMAN VACCINATION COMMISSION OF 1884.

1. With rare exceptions, one survived attack of small-pox confers immunity against subsequent attacks.
2. Vaccination is able to exert a similar protection.
3. The duration of this protection varies within wide limits, but is on the average ten years.
4. At least two well developed vaccine vesicles are necessary to ensure an efficient protection.
5. Revaccination is necessary ten years after primary vaccination.
6. The vaccinated condition of the surrounding *community* increases the relative protection against small-pox which the *individual* has acquired by vaccination, and hence vaccination is beneficial, not only to the individual, but generally.
7. Vaccination, under certain circumstances, may have an injurious effect. In the use of human lymph, the danger of transferring syphilis, although extremely slight, yet cannot be entirely excluded. Any other bad effects are apparently due only to accidental wound diseases.
- All these dangers may, by precautions in the performance of vaccination, be reduced to such a minimum as to make the benefit of vaccination infinitely outweigh any possible injurious effects.
8. Since the introduction of vaccination, no scientifically proveable increase of any particular disease, or of the general mortality, has occurred, such as could be regarded as a consequence of vaccination.

No human institutions work with absolute perfection, but it may be mentioned that out of 2,630,000 vaccinations done in Germany in a single year, 1897, not one was directly answerable for any death, and there was only eight deaths from 'late' erysipelas after vaccination—three per million vaccinations; and six more

deaths occurred soon after vaccination from diseases not connected therewith. No lasting illness followed in any of the non-fatal cases.

THE ROYAL COMMISSION ON 'ISOLATION.'

'We can see nothing then to warrant the conclusion that in this country vaccination might safely be abandoned, and replaced by a system of isolation. If such a change were made in our method of dealing with small-pox, and if that which had been substituted for vaccination proved ineffectual to prevent the *spread* of the disease (it is not suggested that it could diminish its *severity* in those attacked) it is impossible to contemplate the consequences without dismay.

'To avoid misunderstanding, it may be well to repeat that we are very far from underrating the value of a system of isolation. We have already dealt upon its importance. But what it can accomplish as an auxiliary to vaccination is one thing; whether it can be relied on in its stead is quite another thing.'

The Royal Commission was not one of experts in the subject, but a sort of jury before which vaccination was to be put on its trial, the jury to be also the judges, as in ancient Rome. Having laboriously vindicated the claims of vaccination, and shown the absolute necessity of revaccination, instead of giving a scientific verdict they gave a political verdict. They made

The Great Surrender

by recommending Parliament to accept the conscientious objection of the *parent* as a valid excuse for

injuring the community at large by neglecting the vaccination of the *child*. The Royal Commission ought, consistently with their conclusions, to have recommended obligatory revaccination.

The following straightforward statement :—

‘A second vaccination, at the age of twelve, ought to be made compulsory,’

was signed by two medical members by themselves.

In 1898, an Act, to run five years, was passed embodying the ‘conscientious objection’ clause.

In England, in the year 1885, the number of infants who escaped vaccination was 136,000; in 1896, owing greatly to the long delay of the Royal Commission in making their Final Report, the number rose to 350,000; in 1899 the number was only 32,000. During the three years 1898-1900, the successful primary vaccinations were :—500,314; 669,349; 667,655; and the certificates of exemption (‘conscientious’) were 203,413; 32,341; 39,839.

But primary vaccinations alone will not prevent severe epidemics, whereas we know quite well that with universal revaccination small-pox epidemics cease entirely.

England moves very slowly. It took *three-quarters of a century* to establish an efficient system of obligatory vaccination in infancy in this country, just about the time that the great epidemic of 1871-2 was teaching Europe that a single vaccination is not enough. Speaking generally, *the vaccinated who now die of small-pox are adults*. In old times only infants died for the most part: in fact, small-pox kept down the surplus population, it has been said by some. If we are only to have once-vaccination, it were better for the adults for that once-

vaccination to occur in school age, than as at present in infancy. By revaccination adult age is protected; but the revaccination must be universal, to prevent epidemic outbreaks of small-pox.

If our legislators are in earnest about this subject, they will make a fresh departure in Vaccination, and will proceed to enact with all speed a law making *the revaccination of all children attending any school* in the land, public or private, not 'compulsory' but *obligatory under penalties*. This will be far *cheaper* than expensive isolation hospitals—for epidemic outbreaks under our present law will not cease to recur—perhaps this argument will best touch the House of Commons. And compulsory removal to hospital involves far more real compulsion than systematic vaccination—under a central authority of course, not in the hands of Guardians of the Poor. The expression 'compulsory vaccination' should be abolished from all official writings, because it implies physical compulsion. The proper expression is 'obligatory vaccination.' The law imposes an obligation; with penalties for its neglect. *Salus populi suprema lex.*

Our present system is absurd. We are a misguided nation to have obligatory vaccination in infancy only, without its necessary complement, obligatory revaccination in school-age. *It is folly, because we know that revaccination is necessary.*

Surely the country which has bestowed Vaccination upon the world, will not continue to remain behind other countries in utilizing it to the full. The nation that boasts a Harvey, a Newton, a Faraday, a Darwin, that nation also boasts EDWARD JENNER.

APPENDIX.

Small-pox deaths each year per million living.

SWEDEN, 1870-99 (see p. 78).

(Compulsory vaccination 1816; improved 1881).

1870-79 :—183, 78, 81, 261, 936, 461, 136, 79, 44, 31.

1880-89 :—38, 65, 34, 27, 12, 0·8, 0·2, 0·6, 1·5, 0·4.

1890-99 :—0·2, 0·2, 0·8, 5, 3·5, 0, 0, 0, 0·2, 0.

SCOTLAND, 1855-99.

(Compulsory vaccination law 1864).

1855-64 :—440, 436, 281, 110, 224, 489, 250, 137, 526, 552.

Average **345**

1865-76 :—120, 62, 31, 5, 19, 34, 429, 718, 327, 358, 22, 11.

1877-88 :—11, 1, 2, 3, 5, 1, 3, 4, 10, 6, 4, 0.

1889-99 :—1, 0, 0, 3, 17, 32, 11, 0·4, 2, 0·4, 0·2.

Average for 30 years . . . = **64**

Average for last 20 years . . = **5**

NETHERLANDS, 1866-1899.

(Vaccination certificate required on entering school, 1873).

1866-76 :—404, 154, 40, 14, 196, 4,355, 1,021, 95, 34, 50, 29.

1877-87 :—6, 3, 2, 19, 18, 37, 161, 15, 7, 16, 4.

1888-99 :— —, 2, —, 2, 10, 41, 130, 16, 7, —, 1, —.

BELGIUM, 1866-99 (see p. 78).

(*Vaccination not obligatory*).

1870-79:—818, 4,168, 1,560, 333, 369, 313, 270, 669, 678, 430.

1880-89:—748, 480, 279, 310, 229, 279, 204, 100, 146, 202.

1890-99:—105, 211, 408, 336, 85, 46, 20, 21, 24, 38.

ITALY.

(*Population 29,717,982 in 1887; 30,725,000 in 1893*).

Actual small-pox deaths during the years:—

1887-98:—16,249, 18,110, 13,416, 7,017, 2,910, 1,453, 2,638, 2,606, 2,998, 2,033, 1,033, 420. Per million living=547, 609, 447, 234, 97, 48, 86, 84, 97, 66, 34, 13.

Law of December 22, 1888, ordains vaccination and revaccination. Supplementary Laws in 1891 and 1892.

HUNGARY.

(*Population 18 millions*).

Deaths by small-pox during the years:—

1892-98:—4,002, 2,301, 2,544, 2,756, 2,535, 2,105, 1,656. Per million living=222, 128, 141, 153, 141, 117, 92.

Law of 1887 ordains vaccination and revaccination. **Roumania** followed suit in 1893.

The present epidemic in London has cost 808 lives up to March 8, 1902. During 1901, in London the fatality in the vaccinated attacked under 20 years of

age was nearly 2 per cent., in the unvaccinated (under 20) 49 per cent. (*Stat. Com., Met. Asylums Board*).

France has now, Feb. 1902, declared for obligatory thrice-vaccination, viz., in the first, eleventh, and the twenty-first years of life. Thus, besides Germany, we see that Italy, Hungary, Roumania, and Japan, are all using vaccination in the proper way. All these countries have obligatory revaccination in school-age, and France is about to follow.

INDEX.

- Aaron, cited by Rhazes, 2
Ackworth, Yorkshire, 17
Adults, attacked, 56
Agnellus, 4
Ambroise Paré, 8
Amiot, 70
Arabian theory, 3
Armies compared, table, 108
— compulsory revaccination be-
gins, 58
Austria, statistics, 87
— army, 110

Badcock, Dr., 66
Bald, 4
Barry, Dr., 104
Bavaria, 44
— in 1871, 99
Belgium, 78, 82, 94
Bell, Edinburgh, 10
Ben Jonson, couplet by, 10
Birch, 44
Blumenbach, 38
Boerhaave, 9
'Bolgach,' 2
Bollinger, 70
Bouley, 70
Bousquet, 62
Bryce's test, 30

Ceely, 63
— experiments, 65
Chauveau, 66
Chemnitz, statistics, 99

Chester, in 1775, 20
Christleton, (village), 21
Cicatrices, Marson's figures, 63
— Dr. Gayton's figures, 122
Cicatrix theory, 63
Circassians, 24
Clive, 38
Commission, the Royal, 115
— German, 1884, 89
Compulsory vaccination begins, 49
Collie, Dr., 108
Condamine, de la, 11, 23
Constantius Africanus, 5
Copeman, Dr., 68
Copenhagen, table, 12
'Coralis,' 2
Coupland, Dr. Sidney, 120
Cow-pox, nature of, 33
Creighton, 23
Cuvier, 38

Dangers of vaccination, 127
De la Condamine, 10
Degeneration of lymph, 62
Denkschrift, 27
Dewsbury, 120
Dimsdale, Dr., 26
Donatus, 8
Dorchester, Lord, 9
Duvillard, 11

Eileerts de Hahn, 66
Ekkehard, 4
English Chronicle, 8

- England, table, 73
 — in the great epidemic, 81
 Elyot, 7
 Epidemics due to inoculation, 27
 — recur, 53
 — six recent, 105
 — the Great, 80
 Equine, 69
 Eruption after vaccination, 42
 Estlin, 62
 Ettmuller, 9
 Eulenburg, 112

 Farr, Dr., 13
 Fatality, in vaccinated and un-
 vaccinated, 55
 — in 18th Century, 119
 — rate in 18th Century, (Royal
 Commission), 122
 Fermentation theory, 3
 Fernelius, 7
 Fewster, 33
 Fischer, 66
 Foreest, 8
 Flinzer, 99
 Fracastor, 7
 Frederick William, III., 22, 77
 French army, 1870-71, 85
 — — table, 109
 Freyer, 66
 Friedberg, 111
 Friedberger, 70
 Fröhner, 70

 Gaddeston, John of, 5
 Galar-breac, 5
 Galen, 3
 Gayton, Dr., 122
 Geneva, table, 12

 German army, 1871, 84
 — Empire, table, 87
 — Vaccination Commission, 63
 — — Law, 86
 Gesundheitsamt, text, 88
 Gilbertus Anglicus, 5
 Glasgow, 17, 47
 Gloucester epidemic, 106
 Goethe, 27
 Gordonius, 5
 Gregory, of Tours, 2
 — Dr., 64
 Gruner, 5
 Guttstadt, 81
 Guy, Dr. W. A., 14

 Haccius, 66
 Hamburg lymph, 66
 Hastings, 1730, 20
 Haygarth, Dr., 29
 Hering, 62
 Hesse, 101
 Hime, 66
 Homerton Hospital, 117
 Horse-pox, 69
 Hospital, small-pox, 21
 Hufeland, 62
 Humboldt, 33
 Hungary, 94
 Hussty, 30
 Huxham, 30

 Iceland, 13
 Indirect evidence, 93
 Inoculation in man, 24
 — in the cow, 65
 — (Royal Commission), 126
 Invaded houses, 30
 Irish MSS., 2
 Isaac, 2

- Isolation, 29, 60, 131
- Italy, 94
- JENNER, 34
 - Inquiry, 37
 - Further Observations, 39
 - on herpes, 61
 - on equine, 69
- Jensen, 34
- Jesty, Benjamin, 33
- Juncker, Dr., 11
- Jurin, 21

- Keith, Dr., 26
- Kelway, 7
- Kennedy, 24
- Kerchensteiner, von, 84
- Kilmarnock, 17
- King, 66
 - Frederick William III., 22
- Kircher, of Rome, 9
- Körösi, 112
- Klein, 66
- Koch, Dr. R., 90, 96
 - von, 31
- Kübler, 30, 43, 67

- Lafosse, 70
- 'Leechdoms,' 4
- Leicester, 105
- Leipsig, 18th Century, 19
 - Seigel's statistics, 101
 - Wunderlich's, 102
- Lettsom, Dr., 20
- Liverpool, 18
- London, 17th Century, 15
 - 18th Century, 16
 - early in 19th Century, 46
 - 1838-1900, 74
- Lorinser, 104

- Lotz, 104
- Loy, 70
- Lymph, vaccine, 68
- Lyons Commission, 65

- Maitland, Dr., 25
- Maria, Empress, 43
- Marius, Bishop, 1
- Marks, vaccination, 63, 122, 126
- Marshall, J., 14
- Massa, 5
- Matthæus, 5
- Mercurialis, 7
- Mexico, 6
- Moseley, Dr., 44
- Müller, 103
- M'Vail, 17, 29, 126

- Navy, 109
- Netherlands, 82-94
- Nicaise, St., 4
- Norwich epidemic (1819), 53
- Nurses ; statistics, 108

- Oldenburg, 21

- Pandemic, 1870-5, 80
- Pearson, 39
- Peuch, 70
- Phaer, 7
- Playfair, Sir L., 20
- Plett, 34
- Post Office, 112
- Prussia, 1844-69, 78
 - army of, 58
 - epidemic in, 82
 - since 1874, 87
 - vaccination law, 74
- Prussian towns, three, 20

Recurrence of epidemics, 51
 Registrar-General's Table, 128
 Reiter, 66
 Revaccination era begins, 51
 — in Germany, 86
 — of nurses, 108, 126
 Rhazes, 3
 Ring, Dr., 41
 Ritter, 62
 Riverius, 8
 Rolph, 33
 Rowley, 10
 Royal Commission, 114
 — — conclusions, 130
 Russia, 94

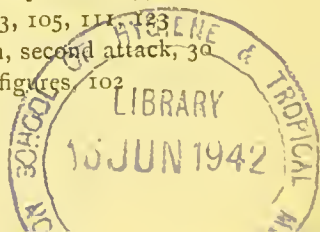
Sacco, 43
 Salmasius, 9
 Sarcone, 30
 Savill, Dr., 111
 Saxon prayer, 4
 Scotland, 81
 Second attacks, 30, 111
 Sheep-pox, 50
 Sheffield epidemic, 104
 Siegel, 31
 Sigbert, 1
 Simpson, 66
 Sloane, Sir H., 24
 Small pokkes, 7
 Small-pox, contagious, 8
 — before vaccination era, 20
 Sovereigns, list of, 10
 Spain, 44
 — recent returns, 95
 Squirrell (= Jones), 34
 Stuttgart, 47
 Süssmilch, 11
 Sutton, Daniel, 26

SWEDEN, average rate since 1880-3, 93
 — before vaccination, table, 13
 — epidemic recur, table, 52
 — vaccination, early results, table, 45
 — 1822-43, table, 72
 — 1844-69, table, 78
 — 1870-75, table, 81
 Switzerland, 104
 Sydenham, Dr., 8
 Syphilis introduced, 6
 Theories, *re* varioloid, 61
 Thiele, 66
 Thompson, 64
 Timoni, 24

Unvaccinated, fatality of, 105, 107

Vaccination before Jenner, 33
 — early results, 45
 — introduced by Jenner, 34
 — neglected, 54
 — rapid spread of, 42
 Vaccinations in 10 years, 91
 Vaccine lymph obtained, 68
 Valescus, 5
 Van Helmont, 9
 Variola, the term, 1
 — always = small-pox, 6
 Varioloid, 54
 Vidus Viduus, 7
 Vogt, 101
 Voigt, 66
 Von Scheel, 97

Warrington epidemic 1773, 123
 — — 1892-3, 105, 111, 123
 Wunderlich, second attack, 30
 — Leipsig figures, 102



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